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JOURNAL

OF THE

BOARD OF AGRICULTURE

OF

BRITISH GUIANA.

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THE EAST COAST FARMERS COMPETITION, 1920.

This competition, which has not been held for some years, demonstrated several salient points relative to the present condition of farming on the East Coast of Demerara.

First and foremost it is clearly evident that little, if any progress has taken place. Why? There are several reasons.

For one, as the Official Report which is reproduced in these pages points out, a more remunerative and easier occupation has been found in Sea Defence work—comparatively high rates of pay and ready money must form attractions almost irresistible to a man who has, perhaps, a five mile walk to and from his farm each day before he can commence work thereon and a possible final prospect of total loss through drought or inundations.

This counter attraction, however, diminishes, as the works near completion.

For another, bad seasons have undoubtedly played havoc of late with these farms. Heavy and continuous rains have been experienced coupled with droughts of no mean severity.

A further point which because glaringly apparent in the adjudication of these plots was the peculiar lack of

appreciation of that most fundamental principle of agriculture in this Colony—namely drainage.

Instance after instance was encountered where every prospect was good and pleasant to behold except the drains which were either choked with grass, only half dug or almost invisible owing to their not having been dug for a long period of time.

Mention has been made above of the distances which separate these East Coast farmers from their lands. It is absurd that almost half a day should be wasted, the better half of a morning's energy consumed before an East Coast farmer can take up either fork or shovel and commence to work on his farm!

The remedy is obvious, yet there is no instance of any one individual exercising his individuality and attempting to adopt such a remedy.

However, indications are not lacking that the future is not without promise. Agricultural Associations are active in many centres and what is more they are fully appreciated. No longer are they regarded (to quote the Resident Agricultural Instructor for the Coast) "as a body of men meeting month after month and talking impossibilities about the tilling of the soil."

MEETINGS OF THE BRITISH GUIANA SUGAR PLANTERS' EXPERIMENT STATIONS COMMITTEE FROM JULY, 1920, TO DATE.

At a meeting of the British Guiana Sugar Planters' Experiment Stations Committee held on Monday, 12th July, reference was made to the apparent discrepancies in the acreage returns under farmers canes on which the contribution by the Government to the Experiment Stations was based, the Committee requesting the Chairman to write to the Town agents of the various sugar estates asking them to obtain from their respective managers estimates of the acreages occupied by farmers canes on their plantations, and if possible, the acreage

cultivated by other cane farmers sending cane to their mills.

The question of drainage for Sophia was discussed at some length. It was decided that the services of an engineer be sought with a view of obtaining advice as to the specifications for a pump and equipment to be erected if found necessary. The Committee arranged to pay a visit of inspection to the Cummings Canal to decide upon the feasibility or not of natural drainage being obtained by means of this canal. A letter from Messrs. Curtis Campbell & Co. in reply to the application from the Committee for the lease of the additional 60 acres at Sophia was read. Permission was granted therein pending a reply from their Principals, for the Committee to have the land cleared if they found it requisite to do so. The meeting decided under the circumstances that no steps could be taken until a definite reply had been received by them from this firm. At this meeting it was decided to offer the post of overseer for Sophia Station to Mr. C. Cameron.

At the meeting held on the 9th August, statements of expenditure to date and estimates of expenditure for year October 1920 to September 1921 were considered. The question of drainage for Sophia was again discussed. It was decided that plans and tenders for the erection of drainage kokers be obtained. The meeting decided that the question of mechanical means of doing work should not be lost sight of in connection with the working of the Station. They had seen excellent examples of work performed by manual labour, but that was not sufficient. They hoped that it would soon be possible for experiments in mechanical tillage to be carried out. The Committee were notified that Mr. C. Cameron had accepted the post of overseer and had assumed his duties from the first instant. The Committee considered that the time had arrived when the organization of the staff should take place and recommended that the necessary regulations be drafted by the Chairman and Superintendent and submitted to the Committee for their approval.

It was decided to allow the labourers at Sophia to

erect a limited number of dwellings on the Station, the site for these would be decided upon by the Superintendent who would see that they were erected to conform with existing Government regulations. The estimates for the coming financial year were next considered, when in view of the large initial expenditure, it was proposed that the assessment be fixed at $1 per acre.

A meeting was held on Friday 10th September when a draft of the regulations governing duties of the Staff of the Experiment Stations was gone through and passed with slight amendments. Regulations relative to sick leave and vacation leave were likewise dealt with and passed. Statements of Expenditure to date were laid for consideration by the Committee. The Estimates for the coming year were considered. The Committee expressed its intention to make a start with the other stations, expenses in connection with which were provided for in the estimates. After a final discussion, the estimates were passed and the Secretary instructed to write to the British Guiana Sugar Planters Association for permission to assess at the rate of $1 per acre.

At a meeting held on 18th October, it was decided to await the arrival in the Colony of Mr. Craig before entering into the final agreement for the lease of the additional acreage. The Committee arranged to meet at Sophia on Monday, 1st November, to decide on the site for the intake koker and other matters. On this date the Committee met and decided on the site for the intake koker. They approved of the employment of a clerical assistant by the Superintendent. With regard to the employment of a chemical assistant they recommended that enquiries be made in Barbados for a competent young man to fill this post.

At a meeting held on 6th December, at which Mr. A. E. Craig was present, the terms of the agreement with Messrs. Curtis Campbell & Co. for the lease of the additional 60 acres were mutually decided upon.

The Committee were informed that efforts to secure the services of a chemical assistant for the Station were so far unsuccessful.

BOTANICAL, PLANT DISEASES AND PEST NOTES.

SUGAR FROM REEDS.

The following note from SUGAR *published in September, 1920, is of interest. It well illustrates the ingenuity and resourcefulness of the Teuton and also gives us cause to wonder whether the large areas of swamp lands in British Guiana which contain quantities of Reeds such as the well known 'Bizzy-Bizzy' (Cyperus articulatus) might possibly be made useful especially as we observe that some of the European Reeds have been found to contain in their Roots "a greater sucrose percentage than some cane varieties regularly planted for sugar production." Also that "a ton of Reed Roots will give about a quart of good alcohol, while under further treatment, a Rum of excellent quality is obtained. By proper treatment with other ingredients, it was possible to manufacture a heavy, dark coloured beer, resembling in taste and appearance porter beer.":—*

In the course of a series of experiments with plants known to have a comparatively large quantity of carbohydrates in their sap, investigators recently tested several species of reeds which grow in abundance in ponds and rivers of Northern and Central Germany. It was found that, while the reeds themselves showed no sucrose whatever, the roots were exceedingly rich therein, containing in fact, a greater sucrose percentage than some cane varieties regularly planted for sugar production. According to the analysis made, reed roots contain 7·15 per cent. of albumen, 29 56 per cent of sucrose, 25·49 per cent. pentosanes, and 30·30 per cent. fibrous materials.

The surprisingly high contents in sucrose naturally arrested the attention of all chemists throughout Germany, and many further analyses were made, as soon as the result was published, with the idea of checking up this discovery. But additional experiments only confirmed the first analysis, and arrangements are now being made to utilize the inexhaustible supplies of reeds for the manufacture of sugar and other products allied thereto. One of the important features of the proposition is the com-

paratively cheap labour of pulling reed roots from the muddy bottoms of rivers and ponds. Ploughs of special construction have been designed for this purpose.

Experiments made with these roots show that, not only can sugar be extracted from them in a commercially feasible manner, even under pre-war sugar conditions, but industrial alcohol can also be manufactured without a single change in the equipment required in alcohol distillers using corn husks, potatoes, and other materials. A tion of reed roots will give about 60 quarts of good alcohol, while under further treatment, a rum of excellent quality is obtained. By proper treatment, with other ingredients, it was possible to manufacture a heavy, dark-coloured beer, resembling in taste and general appearance porter beer.

It has also been found that the resulting mash yields still another product, called 'fragmit," which has been found to constitute an excellent food for horses when mixed with oats, while in its unmixed state it is a good food for cattle and pigs.

FAIR EXCHANGE.

The following extract from the 'Agricultural News' is interesting as the now notorious 'Congo Weed' (Antidesma sp)—an importation into this country—has established itself fully as an agricultural pest. Antidesma, as far as we know, is not attacked by any particularly injurious disease or pest though such may, in course of time occur, even as has happened to Clidemia hirta in Fiji. We note that Clidemia hails from British Guiana, which constitutes, perhaps, an exchange with the outside world for the 'congo weed':—

In a note published in the "Agricultural News" for May 3, 1919, attention was drawn to the danger attending the introduction of uncultivated plants from one country to another. The case in point was that of *Clidemia hirta* a native of the West Indies and British Guiana, which when introduced into Fiji became an agricultural pest.

An interesting sequel to this story is now to hand in the first number of the new "Agricultural Circular,"

January, 1920, issued by the Department of Agriculture Fiji.

Reports were received that *Clidemia hirta* was being killed by a disease. Investigation showed that diseased areas were widespread and occurred chiefly on the poor red soil overlying the soapstone, rarely on the richer alluvial flats, and more frequently in open country than in the bush. The affected patches were very conspicuous, generally occurring on hillsides or hilltops where the plants had the appearance of being very badly windswept, or even at times of having been over-run by fire. The patches were usually clear-cut, as if radiating from a centre of infection.

Individual plants were found to be dying-back from the tips, and the roots to be in a very unhealthy condition. Very few rootlets were present—those that remained bore small nodules—and the larger roots also were frequently swollen. In the dead twigs beetle borings often occurred, and in all parts of the plant fungus mycelium was found. In the nodules, in specimens from several districts, nematode eggs were found, apparently belonging to the genus Heterodera.

Appearances led to the conclusion that the primary cause of the diseased condition was the nematode. The various fungi found enter through wounds made by the nematode, and may cause more serious damage, judging by the fact that on one estate where fungi were most abundant, the disease was most marked in its effect.

The practical importance of the disease is that in the areas affected the Clidemia is dying out, and valuable crops, such as paspalum and reeds are replacing it.

As an experiment, diseased plants of Clidemia have been planted in close proximity to certain plots of cultivated crops. Even should the nematode prove harmless to these particular crops, however, the idea of employing it generally to exterminate Clidemia is not one to be encouraged. Both nematodes and root fungi are serious enemies of economic plants, and should the Clidemia parasites transfer their attacks to some cultivated crop the results might be very serious.

A MOSQUITO SURVEY OF TRINIDAD.

The following Review of a valuable Report to which, unfortunately, we have not access, we reproduce from the 'Agricultural News.'

The Report has recently been submitted by Dr. C. F. Lassalle, Deputy Surgeon and Medical Inspector of Health of Trinidad and Tobago to the Trinidad Government. Editor :—

The surveys on which this report is based were made during two periods—between March 15, 1914 and April 30, 1915, and again from July 1917 to December 31 of the same year. The surveyors were all qualified sanitary inspectors with special training in anopheles survey work, and with a practical knowledge of measures for mosquito eradication. District Medical Officers exercised a general supervision over the work of the inspectors, inspected their diaries once a week, and forwarded their weekly reports, with observations on the same, to the Surgeon-General. The special instructions to the Inspectors contained the following :—

'1. A detailed search must be made for collections of water. Every collection of water, and every receptacle liable to collect water (holes in trees, water-retaining plants) should be carefully examined. Whenever larvae are found, specimens should be collected and bred out for the identification of the species.

'2. Notes must be made at the time of the particulars of the breeding places—nature and extent, sources of the water, the use, if any, to which the water is put, etc. The methods by which the breeding places might be got rid of or controlled should also be considered and noted.

'3. Low-lying ground or irregular flat lands adjacent to high ground, which become or are liable to become flooded during the wet season, should be examined, and the character, extent, etc., noted.

'4. Diagrams of the district, as accurate as possible, should be made, showing with reference to an index:—

(a) Breeding places, distinguishing between permanent, temporary, and potential.

(b) Villages estates, houses, settlements, with the approximate distances from breeding places.

(c) Main line of drainage, and roads.

'5. As far as practicable the habits of mosquitoes should be studied. Houses should be examined, and notes made of the distance from breeding places.

'6. A diary must be kept of the work done, and a summary made at the end of each week.

'7. On completion of the survey, a connected report should be written up, comprising the facts ascertained, and a general description of the physical characters of the district.'

There were employed on this work five inspectors during the first period, and eight during the second. Four of the inspectors were employed during both periods. From the instructions to the inspectors the nature of the survey work is plainly to be seen.

The body of Part 1 of the report gives records of the surveys of the different districts in Trinidad and Tobago, showing the nature of the mosquito breeding places, and giving recommendations for the improvement of the conditions with regard to mosquito control. Pages 43 to 51 give general observations, summary, and recommendations.

Several sectional sketch maps showing breeding places in different localities are included in Part 1. On these maps breeding places are indicated as permanent, temporary, and potential, and the breeding places of some of the most important malaria-carrying mosquitoes are indicated.

The sketch map of Trinidad at the end of Part 1 indicates where mosquito breeding places were found throughout the island.

In the chapter of general observations, summary, and recommendations, the list of breeding places of anopheles which were found during the course of the survey is of interest.

The most important result obtained by the survey has of course been the relation of breeding places to towns and villages, and other considerable centres of population. The districts which were found to be most infested were Chaguanas, Caroni, Oropuche, and La Brea in Trinidad, and Roxborough, Tobago, all well-known malarious localities.

The ideal breeding grounds of anopheles here, as in other countries, are natural collections of water protected from strong light, and renewed by fresh supplies.

The propagation areas found in the course of the survey may be summarized as follows: 1—Slowly running water courses, streams and rivers. 2—Seepage water. 3— Pools and ravines. 4—Ponds, lagoons, swamps. 5—Brackish waters. 6—Low-lying, swampy and grassy lands. 7—Rice fields. 8—Shallow wells and water holes. 9—Mosquito breeding places produced by man: (*a*) borrow pits at the sides of roads and railway lines; (*b*) tapia holes, *i.e.*, holes from which clay has been obtained for building huts; (*c*) culverts—if badly laid. 10—Earthen street and road drains improperly graded or blocked. 11—Water containers, such as old disused coppers, etc. 12—Hoof prints of cows and horses especially in pastures. 13—Wheel tracks of wagons or carts.

Although other species have been found commonly breeding in the stems of plants, the two species, *Anopheles albipes* and *A. argyrotarsis*, which convey malaria in the colony, have not been found breeding in such places.

Remedial Measures.

Under this heading, the following statements and recommendations are given:

'When malaria can be practically extinguished in such a place as the Panama Canal Zone, the same thing can be done anywhere else. Gorgas's fundamental principles in order of importance are:—

'(1) The habitat of anopheles during the larval stage is destroyed with in a hundred yards of dwellings,

since the larvæ of this mosquito live only in clear, fresh water which is plentifully supplied with grass and algae.

(2) All protection for the adult mosquito must be destroyed, since the adult is weak on the wing, not generally flying far, and needing plenty of grass and bush for protection against the wind.

(3) All habitations are screened, but effectively, for screens as ordinarily put up without expert supervision are of little use.

(4) Where breeding places cannot be destroyed by drainage, the larvæ must be destroyed by means of crude petroleum or some other larvicide.'

These principles are not difficult of application, and all remedial measures should be based on them.

Measures for the eradication or reduction of anopheles mosquitoes may be grouped under the following headings:—1—Filling of pools, depressions, swamps. 2—Drainage (agriculture). 3—Oil or petrolization. 4—The use of larvicides. 5—Natural enemies. 6—Cleaning bodies of water. 7—Screening of houses and destruction of adult mosquitoes in houses.

Limitation of space will not allow of comments on all these points, but some of them deserve special mention. For instance, it is stated that 'proper drainage is the most effective method of eliminating malaria,' and again, 'it has been proved in other countries that agricultural operations are powerful antagonists of malaria, and that the disease is reduced or banished from low-lying, unhealthy places in proportion to the thoroughness and efficiency of those operations.'

Proper drainage depends on the right construction of drains, and their maintenance in such a manner that while surplus water is promptly removed, there are no pools or obstructions in which small quantities of water remain as mosquito breeding places. Drainage is fundamental in low-lying lands or in any moisture-retaining soil, as a requisite for agriculture, and such operations as ploughing or forking the surface soil tend to make it porous, and to allow water to penetrate instead of remaining on the surface.

The natural enemies of the adult mosquito are stated to be dragon flies and bats; and reference is made to the recommendation that has been put forward in some countries to encourage the breeding of bats on a large scale. In such cases, in addition to the reduction of mosquitoes, there would be quantities of bat guano available as a fertilizer.

The natural enemies of the mosquito larvae are the larvae of the dragon fly, and several kinds of small fish, esqecially 'millions,' 'ganbin,' 'sardine,' and 'coscorobs.'

The writer of the report draws attention to the fact that in typical anopheles pools and water collections the larvae can easily escape from the fish among the growth of algae, grasses, and other vegetation. These fish are of but little use in controlling mosquitoes, except in water fairly free from vegetation, and with clean, smooth sides and borders.

As for rice fields, which are of importance and cannot be abolished, methods are suggested for reducing the danger of malaria from these. No settlement should be allowed in the rice field, and houses shonld not be nearer than 200 yards on the windward side, or 400 yards on the leeward side of the rice fields. Experiments with fish should be carried out, and trials should be made in the periodical drying-out of rice fields, which, it is said, may be done in such way as not to injure the crop.

The general summary of recommendations is given below :—

1. All surface drains in villages should be properly graded to a suitable outfall into the nearest watercourse or into the sea, and concreted as far as funds may permit.

2. Unpaved earth drains or ditches should be kept free of vegetation, and where small pools of stagnant water form and cannot be drained, oil should be applied to the surface regularly once a week.

3. All low-lying, swampy lands near villages and at a distance of at least 400 yards should be filled in or drained, or both, as found necessary.

4. All useless, shallow wells and ponds should be filled in; until they can be so dealt with they should be regularly oiled once a week.

5. Wherever practicable a pipe-borne constant water-supply should be introduced in every village. This would render it possible to do away with shallow wells and water holes, as well as cisterns and tanks.

6. Wherever such a supply is not possible, the efficient screening of all water receptacles should be secured; advice and instruction in the cheaper methods of screening and, if necessary, the enforcement of anti-mosquito bye-laws would have the desired effect.

7. Borrow pits should be filled in, or, where very extensive, efficiently drained towards the nearest water-course.

8. No new borrow pits should be made anywhere in the neighbourhood of residential settlements, *e.g.*, villages, and estates, unless provision is made for thorough drainage.

9. The current of streams should be accelerated by the regular removal of obstructions, *e.g.*, vegetation, debris, etc., and the courses being straightened and properly drained wherever possible.

10. In the vicinity of villages and estates, water collections which cannot be immediately dealt with should be oiled once a week, or fish should be put into them.

11. Legislation for drainage of swamps and lagoons wherever injurious to health.

12. The early making of anti-mosquito bye-laws, similar to those now in force in urban districts, applicable to all rural districts.

This must be considered as an extremely valuable report—valuable not only as showing what the mosquito conditions in Trinidad and Tobago are, and what means may be taken to make effective a campaign for the greater improvement of conditions in that colony, but also, what is perhaps still more important, as setting an example which ought to be followed in each and every island of the West Indies and British Guiana where mosquito-borne diseases, especially malaria, are prevalent. Indeed, when one considers the amount of inefficiency and the loss of available

effort in the West Indies during the past twenty years, although the relations of mosquitoes to malaria as well as the means of mosquito control have been well known, it seems remarkable that surveys such as that described in the report under review, should not have been carried out in all the West Indian colonies long before this time.

DORMANCY IN SEEDS.

The problem of dormancy in seeds is probably one of the most perplexing in the whole of plant physiology. It is common knowledge that many seeds, after detachment from the parent plant, pass through a period of rest, during which they fail to germinate even under the most favourable conditions of moisture, and oxygen supply, and temperature. Such seeds can often endure the withdrawal of water and dry up, remaining alive sometimes for many years. It is obvious that such seeds cannot be described as dead, since they may retain their capacity for germination for several years. A seed may fail to germinate immediately after harvesting, owing to a state of dormancy in the embryo itself or because of the nature of the seed-coats. The dormancy in the embryo, is due to the need of further ripening processes, which may conveniently be designated after-ripening. More usually, however, the dormancy is due to the seed-coats, which may prevent germination by inhibiting the absorption of water, or mechanically preventing the expansion of the embryo. The seed-coats may also prevent germination by interfering with the absorption of water, or the elimination of carbon dioxide. Soaking in acids is often effective in forcing such seeds, either through modifying the colloids of the seed-coats or changing the reaction of the embryo. Other forcing agents which are often successful in shortening the period of dormancy are freezing, exposure to high

temperatures, desiccation. It is interesting to note that Johnson grass (*Holcus halepensis*) germinates best after exposure to alternating temperatures, whereas the closely allied Sudan grass (*Holcus halepensis sudanensis*) requires a constant temperature; while removing the pulp from camphor seeds may hasten germination of these seeds by two weeks.

Some observations of Kondo on the after-ripening of rice may be of interest. The rice was harvested at intervals in its growth designated as the milk, the yellow ripe, the fully ripe, and the dead ripe stages. Seed harvested in the milk stage was found viable, but to be lacking in vigour. Storage fcr about fifteen days after preliminary drying, or for a month without drying, resulted in quite satisfactory germination. The germination of the yellow ripe grain was also markedly improved after from one to three months storage. Fully ripened grain germinated quite well immediately after harvest, but showed greater viability a month later. Dead ripe grain germinated very readily immediately after harvest, and was not materially benefited by storage. Grain stored in a dry condition completed the ripening process much more rapidly than that stored without preliminary drying, but the latter showed greater viability and vigour. The storage of the unripe grain in the panicle was found to be detrimental in many cases to after-ripening.

Information of this nature is clearly of the greatest value; it is to be regretted that more information is not available concerning the behaviour of West Indian seeds. The possibility should not be overlooked, however, that some of the seeds of these islands may pass through a period of secondary dormancy. That is to say, the seed may be capable of germination immediately after harvesting, but may subsequently pass into a quiescent period, after which it may again be viable. The loss of vitality in seeds is of course a matter of the greatest importance. Rubber seeds for instance, very rapidly lose their viability, thus rendering their transport from one country to another extremely precarious,—*Agricultural News*.

FORMALIN AS AN INSECTICIDE.

The following, as, particularly interesting with respect to mosquito control, is reproduced from *The Field*, August 14, 1920.

According to an announcement in *The Times* of July 22, M. Roubaud, of the Pasteur Institute of France, has discovered that powdered formalin sprinkled on the surface of water in which mosquito larvæ are present, is a sure means of destroying them, and hence of reducing the risk of malaria. The method by which the specific is said to act is interesting. The habitual food of mosquito larvæ consists in minute solid particles and hence they ingest the particles of powdered formalin. These latter give off gaseous formalin in sufficient quantities to poison the larvæ which have swallowed grains of solid formalin. The reflection immediately arises, may not this specific be used in horticulture for the purpose of destroying other pests? It would certainly seem likely that this preparation of formalin may prove a valuable addition to the list of stomach poison insecticides. It is to be hoped that tests will be made in this direction, and also to ascertain whether in its solid state formalin may not prove even more efficacious as a soil sterilizer than it is in the liquid form.

HOUSE FLIES AND FORMALIN.

In the *Journal of the Jamaica Agricultural Society*, August 1920, it is stated that the most effective fly killer is formalin. Half a teaspoonful in a saucer full of water, coloured with milk or sweetened with sugar, will kill thousands of flies per day, Two or three such baits placed about the house are most effective. Although many flies may not be seen in the bait or flying close by, yet, if close attention is paid, many will be found on the floor; they may even fly outside, and then fall. The bait should be renewed every morning.

Trials made with this bait have not given satisfactory results in British Guiana. Much better results were obtainted by the use of flypapers, a formula for the preparation of which was published in a previous number of this Journal.——L.D.C.

NOTES ON FUNGI.

Smut of *Indian Corn* (*Ustilago Maydis*).—During recent years the growing of Indian Corn (Maize) has been more popular in the Colony than hitherto; and to-day, though there is no extensive cultivation of this crop in any part of the Colony still it is grown on a small scale by many farmers in different districts.

The attention of cultivators, is, therefore, drawn to the above-named fungus disease. Though this "pest" is not known to cause damage on an epidemic scale, nevertheless when it does appear, it should receive prompt attention on the part of the cultivator. Hence it is necessary that the farmer should be able to readily identify the "smut," and adopt measures for its control.

Not infrequently corn plants are seen with swellings (locally called "boils" or "bumps") on the leaves, and more usually, on the ears. These growths have, at first, a dull grey covering; later, when this cover is ruptured, innumerable black spores are set free. These spores are capable of directly infecting other corn plants as a result of the wind distributing the spores. Moreover, it is known that the spores are capable of producing infection, when the conditions are favourable, even after they have been dormant for months, and probably years.

Obviously the diseased ears are a direct loss; but the point of real danger is in neglecting to collect and burn diseased ears, and other affected parts, before the spore masses burst. It is not enough to cut out diseased parts and scatter them on the ground; nor should they be deposited in manure heaps or cattle pens. Such practices only intensify the trouble and lead to further infection.

As regards ears for seed purposes, only good ears should be used and these should be selected from disease free fields.

It is possible, even though considerable care be exercised, that spores may be present on the seed. Where a new area is being planted with this crop from seed obtained from an outside source it is advisable to disinfect the seeds before planting by soaking them in a weak solution of copper sulphate (1%).

Red Rot of *Sugar-Cane* (*Colletotrichum falcatum*).—As a prefatory observation—because apparently many tropical agriculturalists are uninformed on the point—one might remark that the sugar-cane (*Saccharum officinarum*) is a cultivated grass. It belongs to one of the largest orders of flowering plants, the Gramineæ, an order comprising upwards of 3,000 species, including the well-known Devil's Grass or Behama grass (*Cynodon dactylon*).

Sugar-cane, like most cultivated crops, is subject to many diseases, some where the malady is comparatively easy to determine, and others where the origin of the affection is more obscure. The affection commonly called red-rot is found in practically every country where the sugar-cane is grown. Loss from this disease is not always apparent, because in some instances there are no obvious external symptoms to be seen in the growing canes.

Generally, however, there are certain external symptoms which lead, on further investigation, to an accurate diagnosis of red-rot. It commonly happens that the intermediate leaves on a shoot show signs of withering The withering generally commences at the apex of leaf, or leaves, and develops on the margins, the mid-rib remaining normal. When the disease is well established in a shoot or stool, all the leaves present a dry and withered appearance.

Further examination, especially by cutting the shoots longitudinally and inspecting the basal internodes, reveals a marked reddening of the tissues. The food vessels (vascular bundles) of the shoot show the discolouration very distinctly, and very often the pith is similarly discoloured. Not infrequently the red-coloured portions are interspersed with white transverse bars, and this condition is distinctive of this affection.

When the disease is in an advanced stage, the pith shrivels, elongated depressions form on the rind, and the canes become very light.

If canes in this condition are examined, small spore masses may be found on the surface on the shoots, near the nodes. The spores are eventually scattered by the

wind and form one of the sources of infection for other canes.

However, so far as is known, the above method of infection is comparatively unimportant, because of the paucity of spores formed.

The chief source of infection is where the disease is carried over in cane "cuttings," i.e. cane "tops"; in other words, the planting of unsound "tops."

Another source of infection is that following wounds in the cane-shoots. In this Colony the cane borer is responsible for a good deal of this trouble. Such wounds give access to the wind dispersed spores alluded to above. It might be thought that diseased "tops" would not germinate or "spring" (the term used locally). This is not so. If the 'tops' are only mildly infected they "spring" quite well, the fungus apparently remaining dormant until the canes are about one-third grown. It is then that the parasite asserts itself and this is probably corelated with the sugar content of the cane. A seed will not germinate unless conditions are suitable; the same is true of the red-rot fungus. When food is available it becomes aggressive and kills the cane.

As regards the control of this disease, some points are quite clear. The primary requirement is to use sound 'tops.' Careful selection of the 'tops' should always obtain, and responsible persons deputed to make the selection. The 'tops' which show a red-discolouration at their cut ends should be rejected. Further, the ends of the 'tops' should be clean cut and not jagged, so as to present a minimum surface only to destructive organisms.

It will be seen that the course of red-rot disease being what it is, the practice of long continued ratooning has its dangers. This applies particularly to areas where red-rot is known to be generally present.

This disease, as indeed all diseases, requires careful and intelligent supervision. Judicious handling in the initial stages will often avert incalculable future trouble.

FRANK STELL,
Assistant Government Botanist and Mycologist,
British Guiana.

AGRICULTURAL NOTES.

The following extracts from Reports by Governor Storm Van Gravesande and Sir Robert M. Schomburgh concerning the cultivation of Rice, the grazing of cattle and the discovery of pitch in Guiana are of very considerable interest and constitute in all probability the earliest references to such matters in official documents.—Editor.

Extract from Governor Storm Van Gravesande's Report to the Zeeland Chamber, June 19, 1750.

The English colonies on the islands and in North America furnish convincing proof what can be done by care of and attention to population; these colonies are not only in a position to maintain themselves but can moreover, in time of war, inflict serious blows upon their enemies (as was proved by the capture of Cape Breton), and far from being a burden upon their mother country they are of great advantage to the latter; this fact being generally known requires no further comment.

If the Netherlands colonies on this continent were populated to the same extent they would not only be able to do the same but more, since the regions occupied by us in South America have many advantages over those in North America, as can actually be proved. But to adduce only one example. The English colony in Carolina derives most of its revenue and support from the cultivation of rice, whereby several planters have from very small beginnings become large capitalists. The soil in our colonies produces rice of much better colour and size than that of Carolina and it has this important advantage over it; whereas in Carolina it takes a year to grow each crop, five months only are required in Essequebo so that here twelve crops can be obtained against five in Carolina. Again, the rice in Essequebo has not the red husk which gives so much trouble in Carolina to get off. It is no doubt for these reasons that the English in Bar-

bados (to whom they are well known) are making so much stir and using so many arguments to dissuade and frighten off those desirous of undertaking this cultivation well foreseeing what injury this would do to Carolina), wherein they have until now succeeded only too well.

EXTRACT FROM SIR ROBERT H. SCHOMBURGK'S DESCRIPTION OF BRITISH GUIANA, 1840—p. 105.

The cultivation of rice would prove a very productive branch of husbandry; and it has formed of late years a principle article of food for the labouring population, it is of great importance that it should be cultivated in sufficient quantities, if not for export, by all means for the internal demand of the colony, which does not employ the resources which she possesses to produce food for her inhabitants. The all-engrossing object, the cultivation of sugar, has for several years usurped thousands of acres which were formerly dedicated to the production of plantains, once the chief food of the labourer. The land on the coast is no doubt well adapted for the production of rice but we will not encroach upon the soil at present planted with sugar-cane. There is a tract between the rivers Berbice and Essequebo, in 4° 20' N. latitude, which nature itself appears to have designed for the growth of that article. It possesses the means of constant irrigation and at the first subsiding of the periodical inundations, when the soil is left like soft mud, the seeds might be put in. The banks of the river Berbice are here so low, that irrigation might be easily procured even in times of great drought. I am fully persuaded in my mind that two crops of rice might be procured annually; indeed it is on record, that a Mr. Rielstein, who cultivated this article on a small scale at the lower Essequebo, raised repeatedly three crops in a year. The cultivation of rice would thus cover thousands of acres which are at present a perfect wilderness; and food for the lower classes would be provided, which is at present mostly imported from a foreign country, which perhaps, at an earlier or later date may be at issue with Great Britain, beside that the rice procured from the United States is raised by slave labour.

Cattle Ranching in the Rupununi District and in "the Extensive Savannahs Between the Rivers Berbice and Demerara."

Extract from Sir Robert Schomburgk's Description of British Guiana, 1840—p. 89.

Savannahs Adopted for Grazing Grounds

The sand-hills are followed by savannahs, which generally extend to the first rocky belt, and are sometimes interspersed with woods and rivulets. They are most extensive between the rivers Demerara and Berbice; they are also frequent between the latter river and the Corentyne; but these must not be confused with those of the Rupununi, which are sterile. The former are clothed with nutritious and wholesome grasses, and in consequence of the number of springs and brooks, and the thickets of wood with which they are interspersed, it appears as if nature herself had pointed them out for the pasture-ground of thousands of cattle and horses. Those between the rivers Berbice and Demerara occupy upwards of three thousands square miles, and the favourable circumstances that they are plentifully watered by tributaries of the Demerara and Berbice and interrupted by wood-land to afford shade during the heat of the day, enhances their value as grazing grounds.

Fitness of Savannahs Between the Rivers Berbice and Demerara for Grazing Grounds.—p. 115.

I alluded in former remarks to the fitness of the extensive savannahs between the rivers Berbice and Demerara, for grazing grounds, and that they are much superior for that purpose to those of the Rupununi. The climate in these regions is uncommonly healthy; and the country so

well watered by springs and rivulets, that the great want of water which exists in the savannahs of the Rupununi and which is such an obstacle that I fear they will never be inhabited by Europeans or their offspring, is here entirely set aside. If, therefore enterprising colonists should cultivate pasturing-grounds, and stock them with cattle from the savannahs of the Rio Branco, fresh beef might be had an equally cheap rate as in the United States: it will then be in the power of the peasantry of British Guiana to provide themselves with fresh meat at a price which bears a relative value to their wages.

Proposed Plan of Leading the Cattle at the Savannahs at Rio Branco to the Coast.

The difficulties which might be connected with leading the cattle at the Rio Branco, to those savannahs between the Rivers Lemerara and Berbice, are comparatively few. They might be led across the savannahs to the foot of the mount Makarapan, where they might be embarked in bateaux or large canoes, which had been constructed for that purpose in tbe vicinity of Makarapan. The forests in these regions abound in crabwood; and if for the transporting of the cattle the period is chosen when the river is full, the cataracts are of little consequence: the large cataracts of the Orinoco are at that period passed in vessels of forty tons. The administrator of the Brazilian cattle-farms at the Rio Branco informed me, while staying at fort Sao Joaquim, that the number of cattle amounted to about five thousand, and that the price was six dollars per head. The pasture of the savannahs of the river Berbice being similiar, and the localities and supply of water superior, to the savannahs of the Rio Branco, the success of farms which were stocked with that cattle would be ensured.

GUIANA PITCH.

EXTRACT FROM GOVERNOR STORM VAN'S GRAVESANDE'S REPORT TO THE ZEELAND CHAMBER, JUNE 19, 1750.

On the sea shore are found waves of a kind of bitumen that can be employed as tar, and being quite as good is known as Barbados tar, for it is in general use there.

CULTIVATION OF THE CASTOR OIL PLANT.

The castor oil plant does well in light alluvial loams, well supplied with organic matter, but in thin, clayey soils, and in sandy soils, the growth of the plant is slow, and its seed production is small.

The plant roots deeply, and the ground must receive a preliminary digging to a depth of from 8 to 10 inches, followed by a harrowing and raking. The longer the land is allowed to lie broken and exposed to the air before sowing, the better.

Fresh seeds from healthy plants germinate readily provided the soil is sufficiently moist. Seeds which have been kept for some time should be softened by immersion in water for a few hours, or a preliminary steeping in a weak disinfectant solution might be useful.

Seeds of the small annual varieties are sown 3 feet apart, or better still, if a subsidiary crop of ground nuts is interplanted, at distances of 2 feet on rows 4 feet apart. The seeds of perennial varieties are usually sown at distances of 6 feet each way, but in the case of large branching plants, wider spacing is perhaps advisable.

As the castor seedling bears transplantation badly, the seeds are planted straight away in the fields. In some cases, however, as many as 10 per cent. have been observed to die in the second month, probably owing to the

presence of eelworms in the soil. Such infested soils should not be planted with Ricinus, but, should the discovery be made too late, it is advisable to have a number of seedlings apart in bamboo baskets, to fill the vacancies, after creosoting the earth at the spot.

After germination, no more watering need be given, except in the case of actual drought. No further care is required, except weeding, and keeping watch for caterpillars which must be kept down by hand picking, and by insecticide sprayings.

The castor oil plant can be interplanted with advantage with other annual crops, preferably the ground-nut (*Arachis hypogaea*) which besides being in itself a very creditable crop, has the advantage of supplying to the soil some of the nitrogen which the castor oil plant takes out of it.

As the castor oil plant exhausts the soil, it should not be cultivated twice in succession on the same ground. A period of at least two years should be allowed between two crops, and it is necessary to devise a scheme of rotation embracing a series of quick growing field crops.

The rotation, Ricinus, ground-nut, gingelly, sweet potatoes, is suggested, these crops being adapted to similar physical conditions of soil. After the sweet potatoes, manuring would be necessary, but as the products of the crops themselves, ground-nut cake, castor cake, etc., provide most of the substances required, the cost of manuring is practically reduced to that of application. Although the castor oil plant is considered to be an exhausting crop, much of the plant food it uses can be returned to the soil in the form of ashes, or better still, in the form of a compost.

Picking of the capsules should begin when the calyces turn from green to brown, and the yellow husks become visible. The fields should be gone over once a week, and the operation may last over two months, or less, if maturity

is hastened by hot, dry weather. The practice of allowing the capsules to ripen, and drop their seeds to the ground, is only admissible where the Ricinus is grown as a pure crop, and the ground is clean and free from weeds.

—*Garden's Bulletin, Straits Settlement.*

HOW TO SELECT DESIRABLE EARS OF CORN FOR SEED PURPOSES.

There are two distinct steps in corn selection. One is to select the most desirable ears, using neither measurement nor score card. The other is to take the ears first selected and judge each one very carefully, noting on a previously prepared score card the value of each character. The first step, which consists simply in picking out the most desirable ears from the crop after it is harvested, does not require much time, but it is one which no farmer can afford to neglect. At the same time these questions should be kept in mind: Will it germinate? Is it pure—that is, will the kernels when planted produce ears of the same size, shape, color, etc.? Is it the shape desirable? How much will it yeild? The following directions will be helpful in determining the approximate value of an ear by looking at it:

Will it germinate? If in doubt, test it. Look for—

Moldiness.—Discard all ears that are the least bit moldy, or that look as if they will not dry out without becoming moldy.

Ripeness.—Discard all ears on which the kernels are very wrinkled, dull in color, or discolored

Insect injury.—The principal dangerous insect is the weevil. A few weevil burrows may not cause much damage, but if corn is much weevil-eaten, the germination will be impaired.

Is it pure? Look for—

Uniformity of kernels.—Discard all ears having kernels of different color; also all ears having many small or undeveloped kernels, or, in general, kernels or different size.

Color of cob.—The cob should be of the same color as the grain, unless difference in color is known to be a variety character.

Is the shape desirable? Look for—

Straightness of rows.—Discard all ears on which many of the kernels are irregularly arrange; also ears on which the rows are very crooked.

Butt.—The butt should preferably be covered with kernels to the extent that a cavity is left after the ear is broken off the stalk. The kernels should retain their size and shape well toward the butt.

Tip.—The tip should preferably be entirely covered with kernels. The circumference of a short ear measured 1 to 2 inches from the butt and 1 inch from the tip, should not differ more than 1½ inches between the points measured. The pointed ear has too many irregular-shaped kernels at the tip resulting in low yields.

How much will it yield? Look for—

Length of ear.—Discard all ears less than 7 inches long. If there are enough desirable ears over 8 inches discard all the shorter ones.

Circumference of ear.—An ear 7 to 7½ inches long should be at least 6¼ inches in circumference but not more than 7 inches. An ear 8 to 9 inches long should be at least 6½ inches in circumference, and a length of 9 inches and up calls for a circumference of 7 inches and up.

Depth shape and space of kernels.—Deep rectangular kernels placed so close together that they can not readily be moved by passing the fingers over them, are sure signs of high yield.

Weight of grain.—Fifty average well-shaped kernels will weigh about 1 ounce. An ear containing 14 rows with 40 well-shaped kernels in each row will have 560 kernels. This would be at least 11 ounces of grain for planting. The irregular-shaped kernels at butt and tip should not be planted. *Circular No 18, Porto Rico agricultural Experiment Station.*

THE CORRECT METHOD OF PLANTING BANANA AND PLANTAIN SUCKERS.

The majority of the farmers on the East Bank, Demerara River have a fair knowledge of the proper depth at which banana and plantain suckers should be planted both in the presence and absence of water in the proximity of the surface of the soil. They pay, however, but ltttle attention to the correct method of planting these suckers so as to minimise destruction by wind when they commence to fruit.

Banana or plantain suckers should be planted at least 12 feet apart and with as light a "bottom" as possible In digging the holes for the reception of the suckers the earth that is removed should not be utilized for filling in the hole after the sucker has been placed in position. A supply of surface soil should be used and it is better to expose the original soil to the action of sun and air before it is again used.

When the plant is about five months old the surface of the soil as far as the leaves shade should be lightly forked. This practice causes the plant to thrive better and attain a large girth with consequent productiveness.

The 'hollow arch' portion of the sucker should, when the sucker is planted, be turned in the direction of the prevailing wind. This should especially be done when no wind break is present or on pegass lands. This prac-

tice causes the plant to put out its branches towards the wind which gives increased stability and consequently saves the expense and work entailed in bracing.

C. HUMPHRYS,
DISTRICT AGRICULTURAL INSTRUCTOR.

SUGAR AND ALCOHOL FROM THE NIPAH PALM.

The Nipah palm (*Nipa fruticans*) is one of the very few tropical plants which occur in pure stands over extensive areas in Borneo. In common with many other palms, its sap contains sugar and laboratory experiments conducted at the Bureau of Science, Manila, indicate that production of sugar from Nipah palm sap would be a commercial success. According to these experiments it is estimated that there would be at least 12 per cent. of recoverable sugar in the sap, and the average annual yield of 4,000 gallons of sap per acre of Nipah under management should produce about 4,000 pounds of sugar.

Although the production of sugar from the Nipah sap is still in the experimental stage, the manufacture of alcohol from the same source is a well established industry. For many years the natives of the Philippines have been producing a low grade distillate averaging about 25 per cent. alcohol, which has been used as a beverage. Lately the crude stills which produced this distillate have largely been replaced by modern distilleries, of which seventy-five were in operation in 1913. These produced 2,500,000 gallons of distilled spirits. Over 98 per cent. of this production is diluted and used for beverages, and the balance utilized as fuel for lamps, stoves and motors.

The Nipah palm grows in dense formation on tidal areas throughout all of the eastern tropics. Very extensive areas are to be found in Borneo, and the British North Borneo government estimate that at least 300,000 acres exist at very accessible points throughout their territory. One block of 57,000 acres has already been surveyed on the west coast and certainly another 100,000 acres can be reached within four hours by launch from Sandakan on the east coast, and the same can be said as regards Tawau on the east coast, but further south.—*Bulletin No. 3. Forestry Dept., British N. Borneo.*

COLONY BIRDS IN RELATION TO AGRICULTURE.

No. 1. The Kiskadee (Pitangus Sulphuratus.)

BY F. STELL. ASSISTANT GOVERNMENT BOTANIST AND MYCOLOGIST.

Visitors, as well as residents of the Colony, soon learn to know this bird by its loud piercing call-note; in fact the call-note is responsible for the common name of the bird. Names derived in this manner are said to be on a matopeic.

The distribution of the kiskadee is quite general. In the streets, at the stellings, about the trenches, in private gardens and open spaces; indeed the kiskadee asserts itself everywhere. Similarly in the wide expanses of the hinterland, the Kiskadee is a prominent member of the bird life, especially in the vicinity of human habitations.

Kiskadees—for there are several species—belong to a group of birds which is commonly called Tyrants.

Upwards of thirty species of this class are present in the Colony and the term is no misnomer, a casual observer will detect that the kiskadee is an assertive, pugnacious bird, with a decided domineering manner.

A close acquaintance shows us that the bird has a disproportionately large head and bill and reminds one of the King-fisher. The length of the bird is about 7½ inches from tip to tip of beak and tail. The plumage is distinctive and well-defined. The breast, vent and under-wing feathers are bright yellow; the wings, back, and tail brown; primaries and tail feathers have a margin of reddish brown. Another conspicuous feature is the black head with a white ring or corona. The chin also is white. Altogether, the Kiskadee is handsome and hardy.

The kiskadee is no epicure. Scarcely anything comes amiss. Not infrequently it may be seen swooping upon its prey of fish. At other times it reminds one of the fly-catcher, so adept is it in catching insects on the wing. The refuse of the kitchen makes it a good meal; and the young of the other birds stolen from the nest are a favourite dish. Thus with its varied diet of flesh, seeds, insects

and fruit, the kiskadee maintains its place in the category of bird-life.

The nidification of the Kiskadee affords little of a striking character. Considering the size of the bird, the nest is large. It is usually built high on some tree and is quite conspicuous. The nesting material is grass. A point to be noted is that the nest has a roof, the entrance being at the side. Three eggs are laid. These are creamy white in colour, spotted with grey and brown.

A question of great economic importance is the relation of animal life to agriculture; this applies to bird-life no less than to the other phyla of animals. In the state of nature, undisturbed by human agency, the balance of nature is maintained. Each animal, and each group of animals, has its enemies by the unceasing operation of natural agencies, equilibrium is sustained.

It is a truism that all animal life on the earth is dependent on the vegetable world. Similarly, the vegetable world is dependent on bird life. If there were no birds the swarms of insects would devour all the vegetation and hence all animal life—and there would be no one left "to tell the tale."

The fact of the matter is, that man by his agricultural operations has both improved and impaired nature's workings. The improvement is shown in cultivated crops, fruits, etc ; on the other hand, the weakness, is that man, by his agricultural work, has upset the Balance of Nature.

The question then arises, what is the ideal to be aimed at by the agriculturist ? Surely it is to secure maximum crops with the least expense. Now the establishment of any plantation involves an artificial arrangement; in other words, a disturbance of the balance of nature. This being the case, it behoves the planter to make use of any and every method which will aid him to rid his lands of pests.

Indeed the utilization of natural enemies, insects, birds etc., is probably the most economical and effective method known.

In this respect the presence and encouragement of birds which feed on insects that are responsible for huge losses to crops, is worthy of consideration.

BUXTON AND FRIENDSHIP FARMERS ASSOCIATION.

THE EIGHT AGRICULTURAL, LIVE STOCK, AND INDUSTRIAL SHOW.

BY E. M. MORGAN.
RESIDENT AGRICULTURAL INSTUCTOR,
BELFIELD, EAST COAST.

The Eight Agricultural, Live stock, and Industrial Show of the above Association was held on Tuesday, 26th October 1920, at the Friendship Wesleyan School Room under the auspices of the Board of Agriculture.

During the year the weather was very unfavourable, but in spite of its peculiarities a fairly successful attempt has been achieved by the association. The number of exhibits were far below that of previous years due principally to the weather as above stated. The importance and far reaching effect of these shows are not yet perfectly realized by the small farmer. This was patent, for the small number of fruits and vegetables exhibited were actually from the same house-hold.!

The quality of the exhibits was satisfactory, this shows a step toward the improvement of cultivation. It is regrettable that more attention is not being paid to the cultivation of fruits, especially those of the citrus variety. Citrus varieties when properly cultivated do well and give remunerative returns and it is be hoped that more attention will be given to this variety of fruits.

The exhibits of Poultry and Cattle were also not numerous, they were on the whole fairly good; with greater interest thrown in this direction a keener competition should be aroused.

The Needle and Fancy-work Section was excellent; the delightful manifestation of locally made hats from leaves and grasses deserve every encouragement.

At one time the Board of Agriculture placed at the various show centres a stand of exhibits not for competition. The object of this was to indicate to the farmer how to exhibit and collect fruits and vegetables, not only for exhibition but also for placing them on the market. It also aimed at giving practical instructions to farmers as to the far reaching benefits derived by selection of seeds and plants. Associations at that time were looked upon by the small farmer as composed of a body of men meeting month after month and talking impossibilities about the tilling of the soil. Happily this doubt of the past is removed by untiring efforts and village associations are now flourishing with good, earnest, and hard working men, who are not only tilling but putting into practice the lessons learnt from time to time by the Board's exhibits.

Our farmers have got to keep before their minds eye that good cultivation, sanitation, and care are necessary principles to be recognised for successful results. From the recent display, it is clear that were it not for the prolonged drought which has, and is still affecting the crops the judges would have had a difficult task as far as vegetables were concerned.

It is to be hoped that farmers will not lose sight of the fact that shows are held principally to give practical instruction and that the monetary gain acts only as an encouragement. Each and every one should avail themselves of the opportunity to be present and so learn the great lessons taught; for it is at these shows the greater number of persons have learnt that our fruits, vegetables, and Economic Products could be converted into various kinds of food as Preserves, Meals, Starch, etc.; besides it serves as healthy rivalry among farmers and gives an impetus to the sluggard who eventually awakes and feels that he should do likewise.

The Board having given all these encouragements, has played a most important part in convincing and bringing back to the associations all those who stood aloof.

Since there is a tendency to improve, the executive officers of village associations will have to excute greater diligence in preparing the prize list. Sufficient time in all cases should be given so that all interested will be able to make early preparation.

The prize list which has been the same every year, should offer additional encouragement towards the cultivation of other crops. In the various classes of the above show many items of importance were left out. Class A. Fruit section—should include Jack Fruit, Peach, Limes, Pomegranate, the two varieties of pine—Monserrat and Water etc. Class B. Vegetables: Giant and Horse Plantians. The different cultivated Yams, two varieties of Tannias, white and yellow, Eschallots, Black eyed peas, Green and dried etc: and Class C. Economies—Tapioca, the varieties of Cassareep, Fibre, Ropes, Wines and many other preserves. Adequate arrangements should also be made for garden plots, Fruits and Economic Plants from selected seeds in pots or baskets. These are all considerations for the future and if adopted will undoubtedly create livelier interest.

FIVE MINUTE CHATS WITH FARMERS.

By Rev. Eric R. O. Robertson.

Dissatisfaction and discontent were never so strongly in evidence among the farmers of the country as they are now. Bitter complaints from farmers of every race reach me almost every mail. What makes it sad is the fact that my correspondents do not belong to the class of grumblers who fill one sometimes with a feeling of disgust. Many of them are men who are making good, honest, industrious, ambitious men, who have won the respect and confi-

dence of their fellowmen. The truth is there is reason for the discontent they feel. Here is a letter from a young fellow who is now employed in the city. He left his farm because it could not pay. He went under with others owing to the drought last year. He writes to ask what hope there is for an Irrigation and Drainage Scheme this year. His loans last year amounted to 200 dollars and he sees no chance of being able to get through another year unless Polder Authorities are formed. So the youths and farm labourers are leaving the farms for the more attractive life of the city. They may as well. As a matter of fact what have they to look forward to. ? It has becone a painful necessity to me to encourage our ambitious young men to emigrate to the United States and to Cuba or anywhere else where they have a chance to live. After all whether a man dies roasted alive in a kerosene box or by slow starvation it is still death only in one case there is the joy of looking for it and in the other he cannot even make a fight of it. Here is another query, contained in a letter received from a canefarmer.

Would you advise me to go on with my canefarm now that sugar has dropped so low? I should like to say that unless cane-farmers are given better treatment, at least, a portion of the offal crop it would be impossible to carry on except at a loss. The matter is at present engaging the attention of the Conference and farmers would do well to follow the discussion that is taking place. I will state the position of the Canefarming Associations. They contend that the most satisfactory system of payment is the gallon system ; that there should be a revision of the basis of payment and such a revision should guarantee to the farmer at least half the value of his crops with half the value of the offal. The Planters have with one or two exceptions shown an admirable spirit and the indications are that the inequalities and injustice of the present system will soon be a matter of the past.

The Committee investigating this matter are now awaiting the report of the Planters Association. My

advice to you is go slowly. Keep your eyes open and watch what the big man is doing, when he tangoes you tango too. Keep step with him.

The most difficult question so far that I have to deal with is that of one of the best men of this country. In a letter to me dealing with the Corentyne Irrigation and Drainage Scheme he asks whether I am satisfied that the farmers of this country need expect salvation in their present evil state judging by the action of the Government and the Electives in refusing by a solid vote to help on any Irrigation or Drainage Scheme of whatsoever character. He points out that the amount raised to carry on the administration of the country has increased during the last five years by half a million dollars and every penny of that money has been raised. He mentions the cost of the Sea Defences and the millions it took. As soon as it is a question for the improvement of the masses we are told there is no money. I am bound to confess that the future is hopeless until the people take matters in their hands. I am a politician but I know that the curse of this country and much of its backwardness is due to party politics where all are for themselves and none for the State.

AVOID HEAT.

One of the causes for corn going bad when stored for keeping is because it is put up hot from the sun. If one thrusts one's hand into a barrel of corn put up in this way, a considerable amount of heat will be felt. Sometimes the corn becomes so hot as to crumble away. Care should always be taken, after drying the corn in the sun or in a drier, to let it cool thoroughly before storing it.—*Journal of the Jamaica Agricultural Society.*

REPORT ON EAST COAST FARMERS' COMPETITIVE PLOTS.

Sir,

We have the honour to submit the following report on the judging of the East Coast Farmers' Competitive Plots at Nabaclis, Victoria and Anns Grove-Clonbrook Sections, which was held on the 8th, 9th and 10th instant.

2. Considering the extent of these village lands, the number of entries at each section was very small, and it is the opinion that general agriculture is not progressive along this portion of East Coast due to the fact that the farmers are at present more or less attracted to the Sea Defence works by high rate of wages and ready money.

3. The few plots inspected, however, were generally well planted and well-kept and showed marked improvement in regards to the cultivation of plantains and root-crops. The great fault at the time of inspection was the weediness of the small drains and in one case the re-digging of the small drains was not completed. This brought the percentage of marks below the standard of 100%. The Fruit Plots inspected were poor. The cane areas consisted of very fine specimens. These did not obtain full marks from the fact that the small drains were not quite clean.

4. The following table gives the results of the judging:—

Total Marks=100
General Cultivation=50 : Drainage=50

Name.		*Marks.*		*Total.*	*Village.*	*Prize.*
C. Adams	Canes	40	45	85	Victoria.	$10 00
Edward Barry	,,	40	35	75	Nabaclis.	8 00
Edward Barry	Provisions	50	30	80	Nabaclis.	14 00
W. Baptiste	,,	45	30	75	Nabaclis.	12 00
James Fraser	,,	30	30	60	Anns Grove.	8 00
Edward Barry	Cassava	45	30	75	Nabaclis.	6 00
Marcus Ned	,,	45	30	75	Anns Grove.	6 00
W. Baptiste	,,	20	20	40	Victoria.	2 00
W. Baptiste	Coconuts	45	30	75	Nabaclis.	6 00
Joseph Andrews	,,	45	30	75	Nabaclis.	6 00
C. Adams	,,	40	30	70	Victoria.	4 00
A. C. Baptiste	Fruit Trees	20	15	35	Nabaclis.	1 00

Sgd. JUDGES :—
G. E. BODKIN, Assistant Director.
A. A. ABRAHAM, Horticultural Superintendent.
F. M. MORGAN, Resident Agricultural Instructor, East Coast, Demerara.

The Director,
Science and Agriculture.

THE EFFECT OF FOOD ON FLAVOUR.

For Iceland, according to the *Journal of the Royal Society of Arts*, there is but little pasturage especially during the winter and at this season the sheep near the coast descend to the beach and climb the rocks in search of seaweed on which they feed. This diet affects the flavour of the mutton however.

It would be interesting to know whether a diet of limes, common to stock in some parts of British Guiana and the West Indies) similarly affects the subsequent meat.

AMENDED BOARD OF AGRICULTURE ORDINANCE.

Ordinance No. 27 *of* 1920.

AN ORDINANCE to repeal and re-enact with Amendments the Board of Agriculture Ordinance, 1910. A.D. 1920.

[23rd October, 1920.]

BE it enacted by the Governor of British Guiana, with the advice and consent of the Court of Policy thereof, as follows :—

1. This Ordinance may be cited as the Board of Agriculture Ordinance, 1920. Short title.

2. In this Ordinance— Interpretation of terms.

"The Board" means the Board of Agriculture established under this Ordinance.

"Agriculture" includes horticulture and forestry.

CONSTITUTION OF BOARD.

3. (1). There shall be established a Board of Agriculture consisting of the Governor, the Director of Science and Agriculture, and such other members hereinafter referred to as ordinary members as shall be appointed by the Governor and every member so appointed shall hold office for three years. Five ordinary members shall form a quorum. Establishment of Board of Agriculture.

(2). The Governor may on the recommendation of the Board appoint any person whether resident in this colony or not to be an honorary member of the Board, but such honorary member shall not have the right of voting at meetings of the Bcard.

(3). The Board may grant such leave of absence to any ordinary member as it thinks fit, but any ordinary member who quits the colony without being granted such leave, or who remains out of the colony after the expiration of

his leave, shall *ipso facto* cease to be a member of the Board.

Chairman of Board.

4. The Governor shall be President and such other person as he may appoint shall be Chairman of the Board, and the Governor may also appoint a Deputy Chairman of the Board. In the absence of President the Chairman and in the absence of the President and of the Chairman the Deputy Chairman shall preside at all meetings of the Board, and in the absence of all three, the ordinary members present at any meeting may elect a Chairman for that meeting. The person presiding at any meeting shall have a casting vote.

Board to be a body corporate.

5. The Board of Agriculture shall be a body corporate, and may sue and be sued, and may for all purposes be described by that name.

Secretary and officers of Board.

6. The Governor may appoint a Secretary and such other officers and Clerks for the Board as may be necessary.

Other Officers of Board.

7. The Board, with the approval of the Governor, may appoint such officers, inspectors, agents or servants as may be necessary for the carrying out of this Ordinance.

Delegation of powers to Committees.

8. The Board may delegate any of its powers to a Committee or Committees of its members, and such delegated powers shall be exercised in accordance with such regulations as the Board may make for the purpose. Any such Committee may, in accordance with such regulations as aforesaid, elect not more than three persons, skilled in the matters delegated to the Committee, not being members of the Board, to be members of the Committee.

Powers and Duties of Board.

Powers and duties of Board.

9. (1.) In addition to the duties imposed and the powers conferred on the Board by any Ordinance passed before or after the coming into operation of this Ordinance the Board shall also undertake the collection and preparation of

statistics relating to agriculture and forestry, and may also undertake the inspection of and reporting on, any schools in which technical instruction practical or scientific, is given in any matter connected with Agriculture or forestry, and the aiding of any school which admits such inspection, and in the judgment of the Board is qualified to receive such aid, and the aiding of any system of lectures or instruction connected with agriculture or forestry, and the inspection of and reporting on any examinations in agriculture or forestry.

(2.) The Board may also make or aid in making such inquires, experiments, and research and collect or aid in collecting such information as they may think important for the purpose of promoting agriculture or forestry.

(3.) The Board shall have the charge and control of the Government Botanical Gardens in Georgetown, and all Forestry and Agricultural Stations in the Colony established by the Government, and all Government Farms.

(4.) The Board may accept the charge and control of any other Botanical or Ornamental Gardens, or pleasure grounds in the colony, and of any Forestry and Agricultural Stations and Farms.

(5.) The Board may make By-laws for the control and management of the Government Botanical Gardens in Georgetown and of any other gardens or grounds and of any Forestry and Agricultural Stations and Farms of which it accepts the charge and control.

(6.) The Board may make regulations—

(*a*) For the holding of Agricultural shows and the management of the same;

(*b*.) For the affiliation to the Board of Local Agricultural Associations, and the Management of the same;

(c.) For the examination of Schools in Agricultural and allied subjects;
(d) As to the duties of the Secretary and other officers of the Board; and
(e.) Generally for the more efficient carrying out of the purposes of this Ordinance.

MISCELLANEOUS.

Proceedings of Board.

10. (1) Every document purporting to be an order, licence or other instrument issued by the Board, and to be signed by the Secretary or other person authorised by the Chairman to act on behalf of the Secretary, shall be received in evidence and be deemed to be such order, licence, or instrument without further proof unless the contrary is shown.

(2.) A certificate signed by the Chairman or any other member of the Board that an order, licence or other instrument purporting to be made or issued by the Board is so made or issued shall be conclusive evidence of the fact so certified.

Financial provisions.

11. The salaries of the Secretary and other officers of the Board and of all persons employed by the Board, and all expenses incurred by the Board in the execution of its duties under this Ordinance, shall be paid out of moneys provided by the Combined Court.

Saving Clause.

12. Wherever in any Ordinance passed before the coming into operation of this Ordinance, the Board of Agriculture Ordinance, 1910, is mentioned or referred to, the Board of Agriculture Ordinance, 1920, shall be deemed to be intended and shall be taken and read in lieu thereof.

Repeal of Ord. 9 of 1910.

13. The Board of Agriculture Ordinance, 1910, is hereby repealed.

Passed the Court of Policy this 24th day of September, 1920.

No. 168.

GOVERNMENT NOTICES.

COLONIAL SECRETARY'S OFFICE,
Georgetown, Demerara,
29th October, 1920.

HIS Excellency the Governor has been pleased, under the provisions of section 3 (1) of the Board of Agriculture Ordinance, 1920, to appoint the following gentlemen to be Ordinary Members of the Board as constituted under the provisions of the said Ordinance :—

The Honourable Cecil Clementi, C.M.G., M.A., F.R.G S., Colonial Secretary.
The Commissioner of Lands and Mines.
The Assistant Director of Science and Agriculture.
The Honorary Secretary, the Royal Agriculture and Commercial Society.
The Secretary, Co-operative Societies.
The Superintendent of Botanic Gardens and Agricultural Stations.
The Superintendent of the British Guiana Sugar Planters' Experiment Stations.
The Honorary Secretary, the British Guiana Farmers' Conference.
Benjamin Gainfort, Esquire, Chief Commissary.
Sidney Howard Bayley, Esquire, Superintendent, Onderneeming School.
The Honourable Robert Edward Brassington.
Edgar Beckett, Esquire, F.L.S.
Henry Leathem Humphrys, Esquire.
Thomas Earle, Esquire.
William Martin Bryce Shields, Esquire.
Arthur Ernest Bratt, Esquire.

No. 169. 29th October, 1920.

WITH reference to Government Notice No. 168 of to-day's date, His Excellency the Governor has been pleased, under Section 4 of the Board of Agriculture

Ordinance, 1920, to appoint the Director of Science and Agriculture to be Chairman and the Assistant Director of Science and Agriculture to be Deputy Chairman of the Board.

No. 170

29th October, 1920.

HIS Excellency the Governor has been pleased, under the provisions of Section 6 of the Board of Agriculture Ordinance, 1920, to appoint Edmund Murray Peterkin, Esquire, to be Secretary to the Board as constituted under the provisions of the same Ordinance.

No. 171.

29th October, 1920.

HIS Excelleny the Governor has been pleased, under the provisions of Section 3 (2) of the Board of Agriculture Ordinance, 1920, to appoint the following gentlemen to be Honorary Members of the Board as constituted under the provisions of the said Ordinance:—

Sir Alexander Swettenham, K.C.M.G.
Sir Frederic M. Hodgson, K.C.M.G.
Sir Walter Egerton, K.C.M.G.
Sir Daniel Morris, K.C.M.G., D.Sc.
Sir Francis Watts, K.C.M.G., D.Sc.
J. J. Quelch, Esquire, B.Sc.

By Command,

C. CLEMENTI,
Colonial Secretary.

THE IMPERIAL ENTOMOLOGICAL CONFERENCE.

ORIGIN.

Arrangements were being made for a Conference of the Official Entomologists in the Dominions, India, and the Colonies to be held in London in 1914; but the outbreak of war necessitated the abandonment of the proposal. In 1919 the Secretary of State for the Colonies revived the suggestion, and a Conference was accordingly assembled on the 1st of June, 1920.

DELEGATES.

The following delegates were selected by their respective Governments to attend the Conference :—

Self-Governing Dominions and India.

Mr. C. F. C. Beeson, India.
Dr. C. Gordon Hewitt, Canada.
Mr. C. P. Lounsbury, South Africa.
Dr. R. J. Tillyard, New Zealand.
Professor R. D. Watt, Australia.

Australian States.

Mr. F. Balfour Browne, Queensland.

Colonies not possessing Responsible Government, Protectorates, etc.

Dr. J. B. Addison, Seychelles.
Mr. T. J. Anderson, East Africa Protectorate.
Mr. G. G. Auchinleck, Mauritius.
Mr. H. A. Ballou, Leeward Islands, St. Vincent and Imperial Department of Agriculture for the West Indies.
Mr. G. E. Bodkin, British Guiana.
Mr. L. H. Gough, Egypt.
Mr. C. C. Gowdey, Uganda Protectorate.
Mr. R. W. Jack, Southern Rhodesia.
Mr. H. H. King, Sudan.

Mr. C. P. Lounsbury, Basutoland, Bechuanaland and Swaziland.
Dr. Aylmer May, Northern Rhodesia.
Mr. W. H. Patterson, Gold Coast.
Mr. P. B. Richards, Federated Malay States.
Mr. F. A. Stockdale, Ceylon.
Mr. F. W. Urich, Trinidad.
Mr. H. Waterland, Sierra Leone

Owing to the death of Dr. Gordon Hewitt shortly before he was to leave for England, the Dominion of Canada was unable to send a delegate, but at the request of the Canadian Government, Mr. Lounsbury acted as their representative at the Conference.

PROGRAMME:

The following programme was arranged for the Conference:—

Tuesday, 1st June.

Morning.—Reception of delegates by Lord Harcourt. Business Meeting: "The Work and Finances of the Imperial Bureau of Entomology."

Afternooon.—Meeting of the Zoological Society of London in Regent's Park.

Wednesday, 2nd June.

Morning.—Discussion: "Legislation in regard to Plant Pests in the British Empire."

Afternoon.—Papers: "Cotton Pests."
"Organization of Entomological Work in the Sudan."

Evening.—Meeting of the Entomological Society of London., 11, Chandos Street, Cavendish Square.

Thursday, 3rd June.

Morning.—Discussion: "The Education of Economic Entomologists."

Afternoon.—Staff Conversazione at the Natural History Museum, South Kensington.

Meeting of the Linnean Society, Burlington House.

Friday, 4th June.

Visit to Rothamsted Experimental Station, Harpenden, Herts, in conjunction with a meeting of the Association of Economic Biologists.

Saturday, 5th June.

Morning.—Discussion: "Tsetse-fly Problem."

Monday, 7th June.

Morning.—Discussion: "Resistance of Plants to Insect Attacks."

Afternoon.—Papers: "Insect Pests of British Guiana."
"Insect Pests of Trinidad."
"Review of the Conditions in the West Indies in regard to Agriculture and Crop Pests."

Tuesday, 8th June.

Visit to Oxford.

Wednesday, 9th June.

Morning.—Discussion: "Artificial versus Natural Methods of Control of Insect Pests."

Afternoon.—Papers: "Insects in relation to Afforestation."
"Insect Pests of Tea in Ceylon."

Thursday, 10th June.

Visit to Cambridge.

Friday. 11th June.

Morning.—Final Meeting of Conference for consideration of resolutions.

Evening.—Official dinner to the Delegates.

PLACE OF MEETINGS.

The Council of the Linnean Society very kindly placed their rooms in Burlington House at the disposal of the Conference, and all meetings were held in these rooms.

Opening of Conference.

Morning Session, Tuesday, June 1st.

The Conference assembled on the 1st of June. Viscount Harcourt, Chairman of the Managing Committee of the Imperial Bureau of Entomology, received the delegates and opened the proceedings. After welcoming the delegates he referred to the importance of economic entomology: and to the established fact that the control of insect life spells success in the treatment of disease and in the production of food and other crops.

He explained briefly the position of the Bureau and the need for further funds to meet the increased cost of upkeep, expressing the hope that if on further acquaintance the delegates were satisfied with the attainments of the Bureau during its existence they would commend it on their return to the greater recognition and generosity of their respective Governments.

Work and Finances of Bureau.

At this first meeting of the Conference the subject for consideration was the "Work and Finances of the Imperial Bureau of Entomology." A memorandum prepared by the Director was circulated, and formed the basis of discussion. The Conference approved the lines on which the Bureau had been conducted and expressed their readiness to leave to the Director and the Managing Committee full discretion as to the general scope and contents of the publications of the Bureau.

A special Committee was appointed to examine in detail the question of finance and to submit recommendations.

The Committee eventually met three times, and after detailed examination of the position, arrived at the conclusion that in order to carry on the work of the Bureau satisfactorily on existing lines, a sum of £13,000 per annum must be guaranteed.

Plant Pest Catalogue.

A Sub-Committee was also appointed to consider the question of expediting the completion of the plant pest

catalogue now in preparation by the Bureau, special attention having been directed to this during the discussion on the work of the Bureau. In view of the recommendation made by the Sub-Committee, it was not thought desirable to provide additional staff for the catalogue, but it was understood that as a temporary measure the Director would engage a third clerk to assist with the work, whose salary would be found from savings, or, if necessary, from the reserve, assuming that the general proposals as to the income of the Bureau are accepted.

Rome Convention.

A Sub-Committee was appointed to report to the Conference on the Convention prepared at the International Conference on Phytopathology held at Rome in March, 1914.

Afternoon Session.

This Session was held at the headquarters of the Zoological Society in Regents Park, London N.W. all the Official Delegates were present also a large number of the members of the Society. A general tour of the grounds was made followed by a reception in the rooms of the Society. Several interesting papers were read by members of the Zoological Society. An especially interesting contribution was a paper by Dr. Chalmers Mitchell well illustrated by lantern slides, on what might be termed the "Zoological incidents of an extended aeroplane trip." Dr. Mitchell accompanied two intrepid aviators on a long flight through certain arid and sparsely inhabited parts of Egypt.

Wednesday, June 2nd.

Morning Session.

In the Chair: Dr. R. Stewart Mac Dougall.

Discussion: Legislation in regard to Plant Pests in the Empire.

The Chairman opened the discussion by pointing out that every country had a perfect right to protect itself against the importation of insect pests from other coun-

tries and also against the internal dissemination of pests. Owing to war experiences considerable enlightenment had taken place with regard to popular ideas of the economic importance of insects.

Mr. C. P. Lounsbury (South Africa) urged that the agricultural entomologist should have a large say in shaping such legislation relative to (1). Plant importations (2). Their internal distribution (3). Insect pests suppression. In support of these points he narrated the experiences gained in South Africa. He also pointed out that import restrictions entail constant opposition and often active hostility and that in some countriës pest regulations have been used to keep out products for commercial reasons.

Mr. Stockdale (Ceylon) then gave a short review of the condition of such legislation in Ceylon drawing attention to some of the defects thereof.

Dr. L. O. Howard (V. S. Bureau Entomology) stated that such legislation was passed to keep out pests and not for any commercial purpose They believed in stringent prohibition and no risks.

Dr. Tillyard (New Zealand) said that in his country the only way to deal with pests was to introduce their enemies from another country. This could not be done owing to the absolute prohibition against insect importation at present existing. This was a good instance of the necessity of such regulations being handled by the entomologists themselves.

Mr. H. A. Ballou (Barbados) remarked on the fact that small colonies like Barbados could only maintain a few highly trained men. He also instanced the fumigation of ships by Clayton gas in Barbados and the inadequacy of the process which was recently proved by its failure to kill a ship's cat which had accidentally become imprisoned in the hold under fumigation. Such legislation in Barbados amounted in its execution to a matter of filling up forms.

Prof. R. D. Watt (Australia) testified as to the desirability of having well trained men to perform such work.

After several other gentlemen had spoken the Chairman proceeded to summarise the various points that had been raised. He suggested that it was evident that certificates by themselves were of but little value. A trained body of supervisors were necessary in each country. A Sub-committee was then formed to consider the desirability of a Rome Convention or an Empire Convention in the matter of dealing with insect pests.

Afternoon Session.

In the Chair: Liet. Colonel Sir David Prain. C.I.E., C.M.G., F.R.S.

Mr. H. A. Ballou Read an interesting paper concerning the insect pests of cotton in the West Indies. Much of the information given in this paper has necessarily appeared previously in the publications of the Imperial Department of Agriculture, Barbados.

Dr. L. Gough (Egypt) gave a condensed account of the insect pests of cotton in Egypt and measures adopted for their control. Later, a number of questions were asked Mr. Ballou, to which he gave answers, concerning the spread of black scale from wild plants to the cultivated cotton and the breeding of cotton stainers.

Mr. Harold King (Sudan) then read his paper "The organisation of entomological work in the Anglo-Egyptian Sudan", which proved of very considerable interest. A valuable discussion ensued in which a letter from Mr. Ballard of Coimbatore, India, was read which suggested an Imperial Entomological service with headquarters in London. A staff of Entomologists would be maintained which could be sent here and there, as the demand arose to work on particular problems. Prof R. Newsted raised an excellent point by remarking that the chief entomologists should run both agricultural and medical entomology. Dr. L. O. Howard deprecated the growing custom

of treating economic entomology as a subsidiary branch of phytopathology.

In the evening a meeting of the Entomological Society of London was attended.

(*To be continued.*)

N.B. In our next issue we hope to conclude this report, publish a general review of the work of this conference and the paper read by British Guiana's official delegate. Editor.

A SURE TEST.

Plants and weeds are as certain an indication of the deficiency or abundance of lime as if a chemical analysis were taken; in fact, they may be considered as even more reliable.

Where is this point always to remember with regard to land deficient in lime: No manurial dressing can exercise its full benefit unless the land contains enough lime to keep it in healthy condition for the working of the soil bacteria, and applications of lime on such soils, although they may produce little immediate effect on the crop to which they are applied, will undoubtedly in the increased results from subsequent dressings of manure. One rule, however, there is to which attention should be called: lime should be used in small quantities as often. It is a greivious mistake to apply a large dressing and then imagine that no more will be needed for many years to come.—SOUTH AFRICAN SUGAR JOURNAL, Vol. 4. No. 8.

Below is a table showing the day of the year 1920 during which the greatest precipitation of rain took place and the amount thereof, al-o the day on which the highest shade temperature was recorded. These figures refer to Georgetown (Botanic Gardens), New Amsterdam (Botanic Gardens) and Onderneeming (Industrial School). No temperature records were kept at Morawhanna (Police Compound) North West District.

Stations.	Wettest Day.	Rainfall.	Hottest day.	Temperature.
Georgetown ...	31st Jany.	4·00 ins....	22nd Oct. 11th & 13th Nov.	89·5
New Amsterdam	9th July	2·73 ins....	1st, 6th–11th Jan. 10th, 12th–15th, 22nd & 28th Feb. 7th, 13th, 15th, 18th, 19th, 21st, 27th, 29th & 31st Oct.	96·0
Onderneeming...	8th Jany.	3·33 ins....	25th Sept. 22nd Oct.	92·0
Morawhanna ...	24th Jany.	5·74 ins....	No records	kept.

AIR TEMPERATURE AND HUMIDITY IN THE SHADE, BOTANIC GARDENS, GEORGETOWN, 1920.

	Air Temperature.			Humidity.
	Maximum.	Minimum	Mean.	Mean.
January ...	84·0	74·8	79·4	81·0
February ...	83·5	74·3	78·9	80·3
March ...	84·0	74·8	79·4	75·3
April ...	85·3	75·8	80·5	73·5
May... ..	85·1	75·4	80·2	79 4
June ...	84·2	75·0	79·6	81·4
July	84·7	74·8	79·7	83·7
August ...	86·2	75·4	80·8	79·6
September ..	86·7	75·4	81·0	77·2
October ...	87·7	76·1	81·9	76·1
November ...	87·3	76·2	81·7	77·8
December ...	84·6	75·5	80·0	80·1
Mean	85·3	75·3	80·3	78·8

By comparison with the figures for a normal year the maximum air temperatures agree fairly well. The exception occured during November which was considerably above the average.

The minimum air temperature in the shade was somewhat higher than the normal during October and November. The humidity was greatest in July and least in April.

Meteorological Data—1920.

BOTANIC GARDENS—GEORGETOWN.

Months.	Rain-fall. Inches.	Number of days of rain. Under ·10 Inches	·10 to ·50 Inches	·50 to 1.00 Inches	1.00 to 2.00 Inches	Above 2.00 Inches	Total Days	EVAPORATION Inches
January	16.40	4	8	1	1	4	18	3.94
February	6.38	8	8	...	3	...	19	4.46
March	1.93	8	7	...	...	...	15	6.21
April	1.12	7	4	...	...	..	11	6.68
May	4.78	11	8	1	1	...	21	5.16
June	11.54	4	7	5	5	...	21	3.88
July	6.84	5	11	5	...	...	21	4.46
August	5.53	4	8	3	1	...	16	5.14
September	2.85	3	5	2	...	...	10	5.57
October	1.22	6	5	...	...	...	11	5.96
November	3.80	2	7	2	1	...	12	5.14
December	12.27	9	8	4	3	1	25	4.99
Totals	74.76	71	86	23	15	5	200	60.69

The rainfall during 1920 was characterised by being well below that of a normal * year. It varied in the following respects:—An abnormally wet January was succeeded by a normal February. The precipitation in March and April was, comparatively speaking, less than usual. May was almost as abnormal as January, being exceedingly dry by comparison with the standard. June, however, was up to the average. The usual dry weather set in towards the end of August and persisted almost to the end of November. The rainfall in December was above the average.

*The rainfall, temperature and humidity figures which we have taken to constitute a normal year will be found in the report on Meteorology for the calendar year 1916, which is included in the 1916 Annual Report of the Department of Science and Agriculture, British Guiana. They are the averages of the rainfall, etc., records for the period 1846-1916.

ATTENDANCES AT THE DISTRICT GARDENS

Year.	Bourda.	Belfield, E. Coast.	Stanleytown, New Amsterdam.	Suddie, Essequibo.	Den Amstel.	Houston, E. Bank.	Wakenaam.	Total Attendances.
1912 ...	5,514	4,395	3,302	2,100	2,544	2,156	718	21,729
1913 ...	5,156	4,535	2,519	3,399	2,568	1,836	1,319	21,332
1914 ...	4,243	3,869	2,443	3,025	1,791	1,653	1,533	18,577
1915 ...	1,123	1,006	769	59	503	339	401	4,200
1916 ...	4,705	1,161	1,510	225	623	2,251	1,297	12,026
1917 ...	4,991	2,820	1,366	3,297	1,186	2,564	1,663	17,886
1918	4,834	3,081	1,653	2,671	2,162	2,790	2,067	19,258
1919	4,769	2,425	1,582	2,798	1,851	2,480	1,556	17,461
1st Quarter	1,235	749	445	397	595	840	483	4,834
2nd Quarter	1,792	560	489	723	790	976	709	6,039
3rd Quarter	1,455	364	229	597	429	600	366	4,040
4th Quarter	1,803	649	502	708	718	812	590	5,782

Total attendances—1920, 20,695.

EXPORTS OF AGRICULTURAL AND FOREST PRODUCTS.

Below will be found a list of the Agricultural and Forest Products of the Colony exported during 1920. The corresponding figures for the two previous and the average for the four years previous to that are added for convenience of comparison.

Product.	*Average 1914-17.*	*1918.*	*1919.*	*1920.*
Sugar, tons ...	90,184	93,901	83,139	83,765
Rum, gallons	3,505,121	2,614,481	4,342,769	1,772,178
Molasses, gallons	46,572	208,262	171,249	420
Cattle-food, (Molascuit) tons	1,870	2,754	2,023	1,783
Cacao, cwts. ...	301	85	85	216
Citrate of Lime, cwts.	190	31	388	63,982
Lime Juice, gals.	6,462	13,846*	10,238†	6,001‡
Essential Oil of Limes, gals.	135	180	826	817
Coconuts, thousands	1,669	1,516	4,693	2,621
Copra, cwts. ...	1,562	2,487	1,367	296
Coffee, cwts. ...	2,358	4,751	8,362	3,642
Kola-nuts, cwts. ...	14	24	None	9
Rice, tons ...	9,666	8,017	6,942	8,094
Ricemeal, tons ...	192	81	None	None
Cattle, head ...	755	332	4	4
Hides, No. ...	3,465	3,291	7,562	5,985
Pigs, No. ...	904	None	None	None
Sheep, head ...	48	10	None	66
Balata, cwts. ...	9,901	10,185	12,546	9,595
Charcoal, bags ...	49,902	41,310	41,380	47,620
Firewood, Wallaba, etc., tons ...	8,256	7,260	6,846	4,852
Gums, lbs. ...	470	60	2,338	3,521
Lumber, cub. ft. ...	222,318	116,771	234,882	297,763
Railway sleepers, No.	11,910	7,743	5,458	14,704
Rubber, cwts. ...	106	214	158	182
Shingles, thousands	2,019	2,842	3,277	2,589
Timber, cub. ft. ...	105,862	31,082	101,383	68,200
Coconut Oil, gals....	16,670	30,652	9,129	20,093

*Raw Juice—12,996 gals....Concentrated— 849 gals.
†Raw Juice— 2,882 gals. ...Concentrated—7,356 gals.
‡Raw Juice— 2,400 gals. ...Concentrated—3,601 gals.

JOURNAL

OF THE

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OF

BRITISH GUIANA.

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THE SPIRIT OF CO-OPERATION.

The spirit of co-operation should pervade the minds and interests of the agricultural community of British Guiana to a far greater extent than it does at the present day. Without doubt some advance has been made during more recent times but it has been slow in coming and is not in keeping with similar forms of progress accomplished elsewhere in the world.

There are a number of cases in point but the following may be chosen as being typical instances of where co-operation should be an essential.

All forms of stock rearing and milk production in British Guiana appear to be performed in a haphazard and perfunctory manner. A recent inquiry into the milk supply of the neigbouring island of Trinidad (to which we hope to make further reference in our next

issue) among other points revealed the fact that much of the poor quality milk was, broadly speaking, directly due to the ignorance of the dairymen themselves as to methods of handling their stock. This could not exist if co-operation existed and knowledge as to proper methods thus disseminated.

The same conditions exist here and co-operation is almost totally non-existent. A parallel instance occurs with the rearing of our cattle, sheep, pigs and other stock.

In this number we reproduce an article relative to the cost of rice production. That co-operation among rice growers is almost exceptional, especially among the East Indian community, is well instanced by the concluding sentence of this article: "none of these statements take into account either the costs of supervision or the interest on the constant expenditure per acre. The former is, of course, very variable in its incident, whilst the latter is largely controlled by whether the padi-grower employs his own capital, borrows from a loan bank or assists in supporting a local usurer and profiteer."

The outlook is by no means gloomy however. We have in our midst numerous Farming and Agricultural Associations, both extant and prospective, equipped with energetic Presidents and Secretaries. While the recently established British Guiana Sugar Planters Experimental Stations Committee indicates that the members of the senior agricultural industry are fully alive to the benefits which accrue from a co-operative spirit.

MEMORANDUM ON THE COST OF THE CULTIVATION OF RICE.

By the Director of Science and Agriculture and R. Ward, Superintendent, Botanic Gardens and Experimental Stations.

During the period 1913 to 1920, both years inclusive, padi was cultivated at the Botanic Gardens and detailed records of the cost of so doing kept. To get a relative insight into the actual costs of producing a bag of 140 lbs. of padi it is necessary to add to the actual expenditure the actual rental value of the land under rice. The costs of supervision and the interest on capital involved should also be included in the calculations, but it is not possible for this to be done in the case of the Botanic Gardens.

The records show that the costs of production of padi differed but little between the years 1913 and 1914; 1915 and 1916; and 1917 and 1918; and hence the mean prices paid for labour and supplies and the crops yielded during these periods are shown in the following tables. The records given for the years 1913 and 1914 may safely be taken as representing the pre-war costs of production of padi at the Botanic Gardens.

For this comparative statement we have utilised only the average results of the large scale experimental cultivations which occupy above 9 acres and have not included in them any results obtained from individual small plots which of course are subject to very great variation.

The yields of padi show a continuous decrease from 1913-1914 to 1920. These decreases may be in part due to less favourable climatic conditions during the later years but probably to a much greater extent to the gradual deterioration of the soil through the long-continued intensive cultivation of rice upon it. The rainfall conditions affecting the yields of rice have been as follows:—

Mean Rainfall in inches and yields of padi in bags of 140 lbs per acre.

	1913-1914	1915-1916	1917-1918	1919	1920
April to July inclusive (period of growth)	33.5	36.9	31.9	49.0	24.3
August to October inclusive (period of maturation)	14.2	10.2	10.6	7.9	9.6
Mean yield in bags per acre	39.0	32.5	30.8	27.1	26.

In the following table the rates and costs of production are shown :—

	1913 & 1914		1915 & 1916		1917 & 1918		1919		1920	
	Rates.	Costs.	Rates.	Costs.	Rates.	Costs.	Rates.	Costs.	Rates.	Costs.
Rent of land per annum per acre ...	$10.00	$10.00	$10.00	$10.00	$10.00	$10.00	$12.00	$12.00	$12.00	$12.00
Water Supply	.25	.25	.25	.25	.25	.25	.25	.25	.25	.25
Drainage	.78	.78	.78	.78	.78	.78	.78	.78	.78	.78
Cost of seed padi, 60 lbs.	1½ per lb.	.90	1½ per lb.	.90	.03 per lb.	1.80	.03 per lb.	1.80	.03 per lb.	1.80
Preparing beds for sowing seeds, 2 men...	.36 a day	.72	.36 a day	.72	.48 a day	.96	.75 a day	1.50	.75 a day	1.50
Weeding, 300 rods	1½ per rod	4.50	.02 per rod	6.00	.02 per rod	6.00	.02 per rod	6.00	.02 per rod	9.00
Forking ,, ...	2¼ per rod	6.75	.03 per rod	9.00	.03 per rod	9.00	.03 per rod	9.00	3½ per rod	10.50
Chipping and levelling, 300 rods ...	1⅓ per rod	4.50	.02 per rod	6.00	.02 per rod	6.00	.02 per rod	6.00	.03 per rod	9.00
Pulling out grass, weeds, etc., 2 women...	.20 a day	.40	.20 a day	.40	.36 a day	.72	.40 a day	.80	.60 a day	1.20
Pulling out seedlings, 2 men	.36 a day	.72	.36 a day	.72	.48 a day	.96	.60 a day	1.20	.72 a day	1.44
Planting seedlings, 8 women	.20 a day	1 60	.20 a day	1.60	.36 a day	2.88	.40 a day	3.20	:60 a day	4.80
Supplying seedlings 4 ,, ...	.20 a day	.80	.20 a day	.80	.36 a day	1.44	.40 a day	1.60	.60 a day	2.40
Weeding 300 rods	1½ per rod	4.50	.02 per rod	6.00	.02 per rod	6.00	.03 per rod	9.00	3½ per rod	10.50
Cultivation expenses, ...		$36.42		$43.17		$46.79		$53.13		$65.17

	1913 & 1914		1915 & 1916		1917 & 1918		1919		1920	
	Rates.	Costs.	Rates.	Costs.	Rates.	Costs.	Rates.	Costs.	Rates.	Costs.
Reaping.										
Cutting carrying, etc., 12 women	.20 a day	$2.40	20 a day	(10w) $2.00	.36 a day	(10) $3.60	.40 a day	(9) $3.60	.60 a day	(9) $5.40
Beating out grain, 12 men	.36 a day	4.32	.36 a day	(10) 3.60	.48 a day	(10) 4.80	.60 a day	(9) 5.40	.72 a day	(9) 6.48
Winnowing grain, 3 men...	.36 a day	1.08	.36 a day	1.08	.48 a day	(2) .96	.60 a day	(2) 1 20	.72 a day	(2) 1.44
,, ,, 2 women..	.20 a day	.40	20 a day	(1) .20	.36 a day	(2) .72	.40 a day	(2) .80	.60 a day	(2) 1.20
Cost of bags	.16 per bag	6.24	.16 per bag	5.20	.32 per bag	9.94	.32 per bag	8.64	.40 per bag	10.40
Sewing twine, ½lb ...	.32 per lb	.16	.48 per lb.	.24	.56 per lb	.28	.72 per lb.	.36	.72 per lb	.36
Needles, 2	.02 each	.04	.02 each	.04	.0 each	.06	.05 each	.10	.05 each	.10
		$14 61		$12.36		$20.36		$20.10		$25.38
Total per acre		51.06		55.53		67.15		73 23		90.55
Per bag		1.30		1 71		2.18		2.70		3.48

The costs per acre of production of padi are divisible into (a) constant, not dependant on yield, and (b) varying dependant on yield per acre and hence best expressed as costs per bag. These were :

	1913-14	1915-16	1917-18	1919	1920
(a) Constant (per acre)	$36.42	$43.17	$46.79	$53.13	$65.17
(b) Varying (per bag)	.37½	.38½	.66	.74	.97

The yields on various sections of the Experimental Fields and with different strains of padi in each yield have varied greatly from 45 bags of padi per acre as a maximum to 12 bags the minimum. The costs of production of a bag of padi in the various years as governed by the yields per acre were as follows :—

Yield Bags per acre.	1913-14	1915-16	1917-18	1919	1920
			Costs per bag of Padi.		
45	$1.17	$1.34	$1.74	$1.92	$2.47
40	1.28	1.46	1.83	2.07	2.60
36	1.39	1.58	1.96	2.21	2.78
32	1.51	1.73	2.12	2.40	3.01
28	1.67	1.92	2.34	2.63	3.30
24	1.89	2.18	2.61	2.95	3.69
20	2.19	2.54	3.00	3.40	4.23
16	2.65	3.08	3.58	4.06	5.04
12	3.41	3.98	4.56	5.17	6.40

During the period dealt with in this memorandum the average yield over the whole area under rice in the Colony and the estimated average costs of production per bag of padi have been :—

Period	Average yield bags per acre.	Estimated average costs per bag of padi.
1913-1914	21.2	$2.11
1915-1916	19.7	3.03
1917	19.1	3.19
1918	8.5	6.16
1919	15.5	4.20
1920	16. (estimated)	5.04

As a check on the costs of production of padi at the Botanic Gardens, the costs of production by certain of the Garden's employees cultivating rice for themselves on lands rented from Plantation Belair and using their own labour as well as hired labour have been determined.

Their average crops have been from about 19 to 23 bags per acre, and the costs have been approximately :—

Year.			
1917 & 1918	...	...	$2.60
1919 ...	...	...	3.30
1920 ...	...	...	3.70

The above results may be summarised that with high yields of say 28 bags of padi per acre the costs of production have increased, from in round figures, $1.70 in pre-war years to $3.30 in 1920; with good yields of say, 22 to 24 bags per acre from about $2.00 per bag to about $3.60 per bag; and with average yields of 18 bags per acre from $2.40 to $4.60.

Average yields of less than 16 bags of padi per acre obtained on land cultivated by hired labour cannot be regarded as commercially successful either in pre-war years or during recent years.

The above data are applicable only to the growth of padi on land already laid out for rice cultivation. Our experience at the Botanic Gardens in 1920 in cultivating rice on lands not hitherto used for its cultivation indicated that at the present high price of labour it is no longer a business proposition to lay out new land for rice-planting unless a yield of at least 25 bags per acre be assured and the selling price of rice be not less than $11.50 per bag.

None of these statements take into account either the costs of supervision or the interest on the constant expenditure per acre. The former is, of course, very variable in its incident, whilst the latter is largely controlled by whether the padi-grower employs his own capital, borrows from a loan bank, or assists in supporting a local usurer and profiteer.

NOTES ON A COLLECTION OF PRESERVED DRY FRUITS AND SEEDS.—(*Contd.*)

By J. F. Waby.

Cynometra trinitensis, as its name denotes, is native to Trinidad. Specimens the dry fruit. This is a rusty brown ball one inch or more in diameter, one-seeded, indehiscent, covered with a woody case one 16th inch thick, with a decided ridge around the centre, the seed filling the entire case, formed of 2 hard nut-like cotyledons; these on being moistened germinate, bursting open the case. Inflorescent in axillary fascicles, one inch or more across; flowers tiny, pure white, crowed together, looking like an immense white catkin 12-15 inches long: every terminal branch covered with flowers, making the tree look like an enormous snowball. Foliage twin-leaved, similar to that of Hymenaea, entire, oblong, thick, leathery, 3-3½ inches long, 1¾-2 inches wide, unequal sided, inner side almost straight, narrow side ½ inches wide, broad side 1½ inches wide, dark green above, pale green beneath, midrib prominent, veins irregular; petiole short. The young foliage as it springs is of a delicate flimsy texture, quite silk-like, making one think the tree is in bloom; this in a week or so becomes quite tense and green. As an ornamental tree it is quite conspicuous; the stem of a pale silver grey, regular. The general form of the tree a closely packed pyramid. Specimens Trinidad.

"Trinidad Purple-Heart," *Peltogyne porphyrocardia.* Specimens, the dry fruits, and heart-wood. Fruit a one-seeded, flat, roundish legume, 1¼ inches long, 1 inch wide, ¼ inch thick, almost straight on one side, rounded top and other side forming a blunt nose; indehiscent, swelling and splitting on becoming damp for germination. Inflorescence terminal and axillary in short panicles; flowers small, white, almost sessile. Foliage in twin pairs, each pair on alternate sides of branches,—stalk but ½ inch long, smooth, tense, leathery, oblong, pointed, 4-4½ inches long, 2-2½ inches wide, dark green above, glabrous

beneath, midrib prominent, veins all very fine, a few serrations on edges. All branches short, angular and brittle, grey or marbled. The stem of the tree is large, grey barked; the centre or heart-wood comprises the greater bulk of the stem, is of a hard nature and of a deep purple colour. Specimens Trinidad.

"The Job's Tear." *Coix lachryma Jobi.* Introduced from India and naturalized in the West Indies. A succulent grass growing to various heights and dimension according to the richness of the soil in which it is planted. Specimens are the pearly grey fruits which are egg-shaped in the general kind seen. Another shape almost round, not very common, was obtained from Barbados as I was on my way to Canada. My first sight of Job's Tears was in the South Kensington Museum many years ago, long before I first left England. These were very much larger than any I have seen since quite yellow with age and of the round type. The stems measure $\frac{1}{4}$ inch or more in diameter tapering towards the summit. The joints are from 3-4 inches long, branching on alternate sides from a leaf-sheath; the main leaves vary from 9-11 inches long or more and $1\frac{1}{2}$—$1\frac{3}{4}$ inches wide, acuminate; secondary leaves smaller and narrower; midrib whitish, sunken, veins all very fine and smooth. Branches 8-9 inches long, secondary branches emanate from those producing the well known Job's tears, these consist of a egg-shaped or roundish fruit, $\frac{1}{4}$ inch in diameter with the "tear" hanging like an "Oat," these are at first green, then black, and lastly grey, hard, smooth.

The plant might have been expected to yield a fodder for Cattle, but evidently this is not the case, as in Demerara, where it is growing luxuriantly as a weed by the roadsides, more particularly up in the Peter's Hall district, it is only cut down as a weed, and the seeds collected for ornamental work as beads. It is an exceedingly ornamental grass when in full bearing. Necklaces

are made of the seeds (fruits) and are very much appreciated, particularly in the States and Canada. Basket work is also made by threading them on thin wire. There is no trouble whatever in piercing them as a needle or fine wire goes straight through. There is a peculiarity about their germination. In giving my lectures to the school-masters in Georgetown, it was necessary to find some grain germinating similar to that of "Barley," and by accident I found the Job's tear seed germinated in the same manner. If the seed was laid on the surface of the ground the radicle portion branched at once and the plumule grew straight upwards, but if the seed were embedded in the ground some distance, the plumule would rise to the surface of the ground like a fine piece of wire and form the base of its stem and stool on the top of it.

"Adlay"—*Coix lachryma Jobi.* This is another variety sent to the Trinidad Department of Agriculture from the Imperial Department of Agricultural in Barbados last year, with a note of introduction from Java where it is grown. "Being grown in Java to a slight "extent for making native beer. The grains may be "eaten like rice or ground into flour and used as wheat. "The kernels easily separate from the husks." Stems 3-3 feet 6 inches high, slender, $\frac{5}{8}$ inch diameter, joints 4-6 inches long, purplish beneath the sheathing leaf-bases. Foliage 2 feet long, acuminate, $1\frac{1}{2}$ inches wide, white midrib. Upper 12 inches branched, bearing the inflorescents in short 3 inch double on treble panicles, with small fruits on slender pendant stalks, one or two or more on each with the "tears" an inch long at the points, the fruits purplish brown, sphaeroidal, fluted, $\frac{3}{8}$ inch diameter, the cases breaking away easily. The stools so far have very few stems, but these may produce more in richer ground. Otherwise the crop of fruits would scarcely be worth growing for.

"Ironwood" *Mesua ferrea* introduced from the East Indies. Specimens the hard-shell fruit. Fruit

$1\frac{1}{8}$ inches long (pointed) 1 inch by $\frac{7}{8}$ inch wide, hard brown shell, dehiscing in 2 valves which split again, and which turn into furrows and form corners. The fruit is exactly like the seed of the molucca or candle nut, though not so hard. The skin closely corrugated, fitting into the Calyx of 4 sepals, each sepal clasping a corner of the fruit, cupped, two—1 inch long, $\frac{3}{4}$ inch wide, and the others (the outer ones) $\frac{1}{2}$ inch wide, and $\frac{5}{8}$ inch long. Inside—when dehisced smooth, pale satiny, containing one brown seed, hard, shaped like the shell of the fruit, with 4 sharp corners $\frac{3}{4}$ inch x $\frac{5}{8}$ inch x $\frac{3}{4}$ inch. Inflorescents terminal in the axils of the last 2·3 pairs of leaves, one flower to each pair alternately. Flower buds oblong with a calyx of 4 reddish—purple or crimson sepals, opening out into concave cups. The corolla of 4 white petals $1\frac{1}{2}$ inches long, $1\frac{1}{2}$ inches wide, narrowing to the centre, edges flimsy, of crêpe-like texture. The centre with innumerable dark golden stamens $\frac{3}{8}$ inch long, filiforme; ovary whitish $\frac{5}{16}$ inch diameter and as high, angular pistil $\frac{1}{2}$ inch long. Foliage in pairs one inch or more apart, petiole $\frac{1}{4}$ inch long; leaves lanceolate acuminate, 4 inches long, barely an inch wide, blade surface pale green, smooth, the midrib whitish, the back of the leaves quite silvery. The sweet-scented flowers are sold in the Indian bazaars by the name of Nagksun, and are as much esteemed as orange flowers are with us. The tree is a tall well furnished pyramid of short brittle pendant branches, forming very dense; the young foliage opening out a bright pink; and the flowers all produced on the outside making a beautiful show. Specimens obtained in the Royal Botanic Gardens, Trinidad.

Momordica cochinchinensis, introduced from the East; a relative of the "Karasla" used by the East Indians in their curries. Specimens, the large dark-brown seeds. These are hard-woody. Shield-shaped dark brown, $1\frac{1}{4}$ inches long, $1\frac{1}{8}$ inches wide, $\frac{1}{4}$ inch thick, with short blunt points all round as if they had been

bitten or gnawed, the base of the shield being the lowest point. One of the most peculiar seeds one sees. The plant is a rampant climber with strong thick succulent ribbed stems. Foliage 4-5 inches apart, palmate, 5 lobed, the centre cut deeply and wide, blunt; the blade 6 inches long, 5-6 inches wide, outer segments $1\frac{3}{4}$ inches long, pointed, lower ones short, auriculate, central rib running from petiole through each, main veins wide apart, dark green above, pale beneath, 2 glands at base, one on each side of the petiole. Petiole $3\frac{1}{2}$ inches long, stout. Inflorescents solitary, large axillary. Flowers monœcious cream coloured, male flowers corolla 4 inches across of 5 foliaceus petals, membranous, ribbed, folding $3\frac{1}{2}$ inches long $1\frac{1}{4}$ inches wide, base of each cupped, the whole base $1\frac{1}{2}$ inches wide, each cup with a dark purplish plash. The staminate organs $\frac{1}{2}$ inch high with yellow anfractuose filaments. Flower stalk $\frac{1}{2}$ inch long, with a brown flattish calyx of 5 points an inch wide. The female flowers are similar in colour, form and size, distinctly marked with veins on the petals, and dark purplish spots at the base inside. The calyx green, $\frac{1}{2}$ inch wide, of 5 filiform extended sepals. The gynaecium of 3 lobes, sub-divided, $\frac{1}{2}$ inch high and rather less wide cream coloured Ovary dark green 1 inch long, $\frac{5}{8}$ inch wide, with closely set short spines; peduncle $3\frac{1}{2}$ inches long, $\frac{1}{8}$ inch thick. The fruit solitary,— hanging by a peduncle which has increased in size since the flower was impregnatad, 6 inches long, $\frac{5}{8}$ inch thick, 7 inches by 5 inches, elliptical closely echinate with short greenish spines, ripening a rosy-red, the shoulders coloured like a greenish calyx, and the point greenish for some time, eventually softening and losing the green colouring; it is succulent, indehiscent. On being cut open, the skin is tense adhering to a yellow putty-like matter $\frac{1}{2}$ inch thick, the base and top thicker, forming an elliptical cavity in which are arranged serially 5 rows of seeds covered with a dark crimson tense putumen, like that of arnatto, the centre to which the seeds are attached being of a dark crimson soft nature. The whole inside of the cavity is stained

dark crimson and bearing marks of each separate seed. The crimson covering of the seeds is easily detached though it may stain the fingers as in the case of the arnatto it is about $\frac{3}{16}$ inch thick, the lower end of the shield is attached to the central mass but loosens when ripe. The sexes do not seem to be well distributed: the first plant to produce flowers only gave 2 female flowers and a quantity of males, the 2 females were polinated and became fertilized. Other plants grown a long distance away only produced a large number of female flowers and these had to be polinated by male flowers brought from the first plant. A very large number of fruits were produced. The fruit is not supposed to be edible, yet as it is so prolific it is a great pity, as it looks as if it might be used as papaws or melons. The seeds yield a certain oil.

BRITISH GUIANA AND THE WEST INDIES AS SOURCES OF POWER ALCOHOL.

At the request of the Department of Scientific and Industrial Research, a questionaire was sent by the Colonial Office on the 26th April, 1920, to British Guiana and the following West Indian Islands: Bahamas, Barbados, Bermuda, British Honduras, Jamaica; the Leeward Islands: Antigua, Dominica and St. Christopher-Nevis, Trinidad; and the Windward Islands: Grenada, St. Lucia and St. Vincent.

The position as indicated by the replies regarding the possibility of producing power alcohol in British Guiana and the West Indies, and of the various factors which influence it, is briefly as follows:—

The principal vegetable materials grown containing sugars or starch, are sugar cane, cassava, rice and sweet potatoes.

Comparatively small quantities of arrowroot, bananas, breadfruit, christophine, eddoes, green corn, maize, tannias and yams are produced, but in many cases in quantities barely sufficient to meet local food requirements.

The only materials of importance referred to containing cellulose are sisal waste in the Bahamas, and "weeds and grasses innumerable" in British Guiana.

The molasses from the refining of sugar is the only raw material for the production of power alcohol which could be made available at present in any appreciable quantity; the quantity depending however, on the price the molasses would fetch for the manufacture of rum and of cattle food. It is somewhat difficult from the replies to arrive at any definite figures as to the molasses which could be turned into power alcohol, it would appear however that not much over two million gallons a year could be produced. In this connection information has recently been furnished by the West India Committee to the effect that, based on an estimated output of 300,000 tons of

sugar, yielding 40 gallons of molasses a ton, and allowing for the molasses for rum and other purposes. there would be enough molasses for about 3,400,000 gallons of 95% alcohol; in either case the quantity is small.

The possibilities of the manufacture of power alcohol from molasses in British Guiana and the West Indies, or alternatively of sending the molasses to this country for conversion into power alcohol, were discussed at a conference held recently at the Department of Scientific and Industrial Research, at which the West India Committee and the home distillery interests were present, and the matter is being considered by them. It would appear that only concerted action by these two bodies is likely to produce results so far as molasses is concerned.

The only other raw material mentioned in the replies as existing in any quantity is sisal waste in the Bahamas, which on the figures given should be capable of producing about 530,000 gallons of 95% alcohol a year, and weeds and grasses in British Guiana; no particulars of the latter are given, however, and they cannot be regarded as an immediate source of power alcohol owing to their being no cheap and simple process for their conversion.

The other main crops, namely, cassava, rice and sweet potatoes do not appear to be produced in quantities in excess of local food requirements, and their present prices make them prohibitive as raw materials for the production of power alcohol. Increased output on a scale much in excess of food requirements would no doubt reduce prices, but it is a question whether the reduction would meet a level at which the material could be used for the production of power alcohol, before it would no longer pay to grow the material at all. In this connection there is a factor which cannot be lost sight of, and that is the tendency of the agricultural produce of the islands towards Canada and the United States.

The possibilities of increasing the production of the sugar-cane, cassava, and other raw materials depends, in great measure, on the supply of labour, and it would appear that, owing to the stoppage of East Indian immigration, labour is scarce, particularly in Trinidad and

British Guiana. In Jamaica difficulties of labour supply exist owing to the increased exodus of labour to the neighbouring South American Republics, where rates of pay are higher. The question of Indian labour has been taken up with the Indian Government, and in Trinidad the wages question has been under investigation by a Wages Committee. Apart, however, from scarcity unskilled labour is cheap, and what there is of skilled labour is comparatively cheap also.

Another matter which would adversely affect the cost of producing power alcohol in the West Indies is the absence of coal, except what is imported at a cost prohibitive for such a purpose. Wood is the common fuel; but in most cases it is neither abundant nor cheap.

The provision of the necessary supplies of water might also present difficulties in many of the islands.

Conclusion.

Of the raw materials in British Guiana and the West Indies suitable for the manufacture of power alcohol, the only one produced in any quantity is molasses, and the availability of molasses depends upon whether a higher price can be paid for it for this purpose than it will command for the manufacture of rum and of cattle food, which is unlikely unless the demands for rum become much less. The quantity of 95% alcohol which could be produced from the molasses not now used for other purposes would not on the most favourable estimate, much exceed 3,000,000 gallons a year.

Other edible vegetable materials are not produced in excess of food requirments, and the only waste product of importance referred to is that from the treatment of sisal in the Bahamas which, on the present method of working the sisal, would produce about half a million gallons a year of 95% alcohol.

In view of the labour position in British Guiana, and the larger West Indian Islands, and to the scarcity and high cost in many cases of fuel and water, the prospects are not very promising of increasing the cultivation of materials containing sugar or starch to such an extent as

to largely exceed the demands for foodstuffs, and by so doing of obtaining a cheap supply of these materials for the manufacture of power alcohol. At the same time there is no doubt that cassava can be grown freely in British Guiana giving a yield of six to eight tons of tubers an acre, with possibilities of increase if the best varieties are selected and properly cultivated a yield of say 7 tons an acre would produce about 250 gallons of 95% alcohol, a very good return.

The total area of British Guiana is below 57 and 58 million acres, of which over 10 millions are easily accessible, and of these again only about 200,000 are actually under cultivation, there should be therefore plenty of land on which additional cassava could be grown.

The cultivation of cassava has also been studied in Trinidad and St. Vincent and in the latter island the conclusion was arrived at in the report of the Agricultural Department for 1918—19 that, provided the cost of production could be lowered by improved methods of cultivation, etc., the manufacture of power alcohol from cassava might be found to be profitable.

Provided therefore that labour and fuel difficulties could be overcome, the cultivation of cassava on scientific lines as a raw material for the manufacture of power alcohol would appear to offer possibilities in the West Indies, and more especially in British Guiana.

MEMORANDUM ON THE PRODUCTION OF INDUSTRIAL ALCOHOL IN BRITISH GUIANA.

Including the Replies to the Questionnaire previously alluded to which was sent out by the Department of Scientific and Industrial Research.

BY THE DIRECTOR OF SCIENCE AND AGRICULTURE.

Several years (13 to 16) ago much attention was directed in British Guiana to the possible use of crude spirits of from 85% to 92% absolute alcohol by volume for fuel and lighting purposes. A memorandum was prepared and published; the section of the Spirits Ordinance dealing with the methylation or denaturation of spirits was amended and re-cast and special Orders as to the methylation or denaturation of spirits were issued by the Governor-in-Council.

Trials were made on certain plantations with motor-ploughs using crude spirits as fuel in internal combustion engines. These soon ceased as the market price of rum rose far above its parity with that of petrol. At present this position is accentuated and there is not any likelihood of industrial alcohol prepared from locally produced molasses falling below the parity of imported petrol unless British Guiana either "goes dry" or the retail prices of imported spirits—gin, hollands, brandy, and whisky—fall so low as to materially prejudice and thus restrict the consumption of locally produced rum. A similar position would be produced by the prohibition of the consumption of rum in Great Britain and her dependencies, or by their imposition of duties on rum so high as to very materially lessen its consumption, In such cases approximately 3,000,000 gallons of industrial alcohol could be prepared in British Guiana from the molasses produced on the areas at present occupied by sugar cane. But there would always be the possibility it might pay the planters better to utilize the residual molasses as a constituent of cattle-food as is now done in the case of molascuit, than to convert it into industrial alcohol.

Should any marked increase take place in the areas planted with sugar cane or in the yields thereon, it may become necessary to either convert some of the residual molasses into industrial alcohol; or to use it in compounding cattle-foods, or directly as fuel.

The answers to the Questionnaire are as follows:—

(1.) *Which of the following materials does the Colony produce :—*

(a) Sugar or sugar-containing materials.	Sugar-cane (i. e. molasses as a residual product in the manufacture of Sugar)
(b) Starch or materials containing starch or similar carbohydrates.	Rice (padi,) bananas, plantains, cassava, yams, sweet potatoes, arrowroot, tannias, eddoes, maize and guinea corn.
(c) Cellulose containing materials, apart from wood and textile fibres ?	Weeds and grasses innumerable.

(2.) *What areas are under cultivation for the above materials?*

(a) 71,000 acres.
(b) Rice, 61,000 acres; other starch-containing materials, 18,000 acres.
(c) Cannot be stated; their growths are neither under cultivation nor under control.

(3.) *What is the normal yield of these materials in tons per acre?*

(a) *Sugar-cane* from 5 to 60 tons per acre per annum. Average yield from 20 tons per acre in ordinary years to 24 tons in exceptionally favourable years. On good land under favourable conditions of rainfall, irrigation, drainage and cultivation, the average yields vary from 25 to 33 tons per acre.

(b)

	Periods of growth Months	*Normal Yields in Tons per Acre* Raw material			equal to	Starch		
Rice (padi)	5 to 6	.6	to	2.1 Average 1.1 ton	,,	.4	to	1.3 .7
Bananas, Cavendish or Chinese	14	6.	to	8.	,,	1.	to	1.6
Plaintains	16	3.	,,	5.	,,	.7	,,	1.1
Cassava	9 to 11	4.	,,	8.	,,	1.2	,,	2.4
,,	15 ,, 17	7.	,,	15.	,,	2.1	,,	4.5
Yams	9 ,, 11	1½	,,	3.	,,	.75	,,	1.5
Sweet Potatoes	4 ,, 5	2.	,,	4.	,,	.4	,,	.8
Arrowroot	9 ,, 11	...		...	...	.35	,,	.7
Tannias	10	½	to	2.	,,	18lb	,,	72lb
Eddoes	10	1½	,,	2.	,,	.07	,,	.10
Maize	4 to 5	.35	,,	.55	,,	...	...	...
Guinea corn	3 ,, 5	.45	,,	1.2	,,	.35	to	.9

(c) Not ascertainable.

(4) *What quantities of these materials could be made available for distilling purposes?*

The residual molasses containing, say, from 9 to 12 per cent. of the total sugars in the sugar-cane.

(b) Under present conditions of lack of population and exceptional high cost of (tropical) labour, none.

(c) None. (No labour available for the exploitation of these.)

(5) *At what price per ton could supplies of these materials be available at the point of cultivation?*

Cannot state. Dependent entirely on the availability and the cost of labour.

(6) *What transport facilities are available and what would transport of these materials cost per ton?*

(a) River, or road, or railroad according to the position of the land.
(b) Cannot state. Dependent almost entirely on the availability and the cost of labour, as well as the cost of fuel.

(7) *What is the cost of skilled and unskilled labour in the Colony?*

Varies according to locality and the nature of the work. At present rates for unskilled labour are approximately:—

Agricultural workers	
Boys and women	1/8 to 2/6 per day
Men	3/- „ 5/- „ „
Porters	
Porters and dock-labourers	6/- „ 10/- „ „
For skilled labour Men	5/- „ 12/6 and upwards per day.

(8) *What fuel and water are available for manufacturing purposes and at what price?*

Fuel. Wood, and in the case of sugar-cane, megass.
Water. Rain water, river water, and conservancy water.
Fuel. Wood costs from 11/- to, at present 21/- and upwards per ton.
Water. According to its source; and to expenses of collection and conservancy.

The cost of water supplied from the great co-operative water conservancies varies from about 5d to as much as 2/- per acre to which water is served.

(9) *Is alcohol of 95% strength being produced on an industrial scale in the Colony and if so*

(a) *From what raw material?*
(b) *In what quantity?*
(c) *At what price per gallon of 95% strength?*

Not at present. Some was formerly prepared from residual molasses. It is not possible now to state the quantity produced for such purposes or the price which it cost to make the spirits.

(10) *If not, is it thought probable that 95% alcohol could be commercially produced in the Colony, from the material mentioned.*

When if ever, the price of rum as a beverage falls below its cost of production, it may be feasible to prepare industrial alcohol from residual molasses, Whether this will be done will be dependent upon the relative value of molasses used as an ingredient of cattle-food; concentrated almost to a solid mass for export; used directly as a fuel, or converted into 95% spirit.

The only other cultural sources from which industrial alcohol could be produced on the commercial scale, would be cassava and rice. But it does not appear at all probable that the colony which does not, has not, and, under present labour-conditions, cannot produce a sufficiency of vegetable or carbohydrate foodstuffs for the needs of its population, is at all likely to commercially produce carbohydrate materials for conversion into industrial alcohol. For the only carbohydrate foodstuff it produces in quantity in excess of that required for feeding its population—riçe—the Colony has assured markets with prices considerably in excess of what rice could be sold at for alcohol-producing purposes.

Hence it is not probable that in the immediate future British Guiana will produce industrial alcohol of 95% commercially.

LIBERIAN COFFEE.

Its Cultivation and Preparation for the Market.

By W. H. MATTHEWS, Resident Agricultural Instructor, Pomeroon District.

The planting of Liberian Coffee is fairly widely performed throughout the Colony, but unfortunately sufficient attention is not given to its cultivation; hence the crops obtained are for the most part mediocre. For the purpose of helping growers to get the best possible yields the present article is written. In it are indicated the lines along which the plants should be cultivated for best results, and as at present prices for the finished product are low, increased output is necessary to offset low prices.

By strict adherence to the principles enunciated, maximum yields will result.

Soil:—A clay soil not too stiff in texture and containing a fair percentage of vegetable matter is best for the cultivation of Liberian Coffee—while a pegassy soil grows this species of Coffee well, and indeed during the early growth of the plant it far surpasses that made by plants in soils of a clayey nature, it is, however doubtful, whether yield will be maintained so well in a pegassey soil as is the case with more fertile clay soils.

Drainage:—The provision of proper drainage for Liberian Coffee is a matter of first consideration—where the land is insufficiently drained the leaves of the plants show it by their pale yellow colour, regaining their dark green healthy colour only after the drainage has received attention.

Selection of seed:—Next in importance to proper drainage comes seed selection, as upon selection depends future yields, while it is possible in the case of short growing crops to correct errors due to bad selection or rather non-selection of seed this is not possible in the case of coffee and other permanent crops which keep on growing for years after having once been planted. Therefore it is a case with these crops of selecting "now or never."

In the case of farms or estates that are being started in districts where Liberian Coffee is not grown, perhaps the most convenient way to get plants would be to purchase plants in baskets—but in the case of established farms, where the farmer is desirous of extending the cultivation, selection of berries from his best bearing trees is recommended. As, however, selection embraces many points, it had better be given in detail below:—

(1) Ascertain during crop time the plants which give the best yields, noting (a) habit of plant as to vigour and growth (b) proportion of skin to bean in the berry.

(2) See that the plants chosen as seed-producers conform to one particular type—Liberian Coffee plants exhibit great divergence of types, hence this restriction—

choosing only one type of plant tends to uniformity of the offsprings and makes maximum yields a certainty.

(3) Having paid due regard to the above points in selection, gather from the plants chosen only berries that are fully ripe, (the colour of a fully ripe berry is a deep red) and the largest ones. It is also advisable to have the berries all of one size or as nearly so as possible.

Sowing:—After completing the selection of the berries, the berries can either be sown straightaway, that is, as they are in berry form; or they may be first pulped to separate the skin from the seeds, the mucilage being washed off the seeds with water, and the seeds air dried and then sown.

The correct way to sow coffee seeds is in small beds, say, 3 feet to 4 feet wide, prepared across a large 3 rod bed, paths of 18 inches being left between each for walking. These small beds should be sufficiently loose in texture and well drained. If not sufficiently loose by nature they may be made so by the incorporation of vegetable matter. Such a nursery should be made in a central place in order to facilitate the transportation of the plants to their permanent places at planting time.

As too much transplanting tends to check the growth of seedlings it is advisable in sowing the coffee seeds to set them rather far, say, 9 inches apart each way, that is, 9 inches between the rows and 9 inches between the seeds. To allow for possible failures two seeds may be set at each 9 inches space, removing one, of course, should both seeds germinate and grow. Plants growing from seeds set thus far make more robust growth and consequently do better after they have been permanently put out in their places in the field than do plants that have been set rather closely in the Nursery beds and as a consequence make leggy growth. The reason why the former make more desirable plants is the fact that widely spaced seedlings grow leaves from very near the ground and as a consequence branch low down while the leggy plants begin branching higher up the stem. It will thus be seen that in a given distance from the ground the

former will have more branches to the plant than the latter and consequently yield more.

Germination of coffee seeds takes place in 6 weeks. After sowing, watering should be done and weeds removed, and so regularly on until the seedlings are ready to be permanently planted out, shade should of course be provided for sheltering the seedlings during the heat of the day. In connection with watering only sufficient to keep the soil moist is necessary, as over watering is more harmful than beneficial, giving rise to dampness.

Preparation of the land for planting:—Before the plantlets are ready to be planted out it is requisite that the land be laid out in beds 3 rods wide by digging 2′x 2′ drains at every 3 rods. the earth thrown out of the drains in digging being thrown along the centre of the beds and so raising the middles. After the beds have been formed, lining should be done so as to mark the places in the beds where the plants are to be permanently planted. The beds being 3 rods wide leave out from each drain 6 feet distance and run rows on either side of the bed parallel to the drains and 6 feet distance from each, you will have then 2 lines or rows 24 feet apart. As it is, however, necessary to have your rows only 12 feet apart a middle row can be put in midway between the two outer rows, thus allowing 3 rows to the bed, each row being 12 feet apart, and the outer rows 6 feet from the nearest drain. The rows having been correctly spaced and run, mark off in the rows the places where the plants are to be set, leaving a distance of 6 feet clear from the edge of the bed—The first plant in each row being 6 feet from the "bed head" peg off from this every 10 feet along the row until the other end of the bed is reached and then similarly deal with the other beds, row by row. The planting distance for each plant will therefore be 12 feet by 10 feet, meaning 12 feet between the rows and 10 feet between each plant in the rows. Undoubtedly planting in rows takes time but the ultimate gain more than compensates for the little trouble taken. By planting in rows each plant is given its own space, its own share

of light, air and soil, and consequently uniform growth is made by the plants, resulting in a uniform yield.

After lining is complete, unless the soil is very loose in texture, holes should be prepared for receiving the plants. By preparing holes is meant the excavation of the earth around each peg and the peg being the centre of the hole. The size of the holes should be 24 to 30 inches wide and 12 inches deep. The soil removed from the holes should then be well chipped and mixed with vegetable matter before returning it to the hole, raising the middle so that the finished hole is mound-shaped. Some people look on the recommendation of holing as being "high-falutin" but surely a little extra attention given to a plant that is to continue in one place, not for months, but years, is desirable. In the life of such plants the extra cost of making them comfortable and giving them a good start is more than counterbalanced by subsequent yields.

Planting:—This is to be preferably done during showery weather when sun and rain alternate. Afternoon planting is best, that is, any time after 3 p.m. The plants are carefully lifted from the beds, small openings on top of the mounds in the field made and the plants planted, pressing well down around the roots with the hands or feet as the plants are put down, after which draw up a little loose soil above the roots and about the stem but not too high up. This drawing up of the soil around the stem and over the roots will check evaporation from the soil below and confine the moisture in the vicinity of the roots where it is most needed. As a guide how deep the plants should be planted, note the mark on the stem showing depth at which they stood in the nursery beds and put them down at this depth.

Plantlets 6 to 8 inches are best for planting out in the field: although some people prefer to plant when smaller, and others when larger. Watering after planting is advisable in order to settle the soil well about the plant roots. The cooling effects of water on the roots also help plants planted in the afternoon to pick up during the cool of the night and so be in better position to withstand

the heat of the sun, should the next day after planting be a very hot one.

After-cultivation :—After cultivation embraces weeding, pruning, forking about the roots during the early stages of growth, topping and gathering the ripe berries annually after fruiting begins.

Weeding :—Liberian Coffee is a plant that must be kept quite free from weeds—clean weeded, that is, where grass and weeds are allowed to grow unrestrained the leaves of the coffee plants become very pale tending towards yellow. Further, if the grass is of the high growing kind it will be found that the lower bearing branches of the plant gradually die, while suckers arise from low down the stem giving the plant altogether quite an uncultivated look. Proper and regular attention to weeding enables the plant to make uniform growth and to maintain its healthy appearance. as is evidenced in well kept farms. As a means of keeping down the growth of weeds and at the same time getting the means of livelihood during the waiting years between the planting and gathering in the first crop, catch-cropping with ground provisions is usually done. It should not be forgotten, however, that such provision crops as are grown between Coffee are secondary to the Coffee, hence any encroachment on the Coffee plants should be prevented by sacrificing the provisions for the Coffee and not, as is often the case, the Coffee for the ground provisions. Each year as the Coffee grows and spreads the ground provisions should be planted farther and farther away, thus enabling the coffee to do its best and arrive earlier at maturity.

Pruning :—The Liberian Coffee is such a very good bearer that it will give fair returns for the minimum amount of pruning done. This fact is so well recognized by farmers, generally, that they rather under-prune than over-prune. Yet it has been the writer's experience that pruning done early and regularly has a decidedly invigorating effect on the future yields of plants. Pruning to be effective must be begun as above-said early in the plants life, and in the nursery beds, should suckers arise

on the main stem of young plants. Many farmers regard the many-stemmed plant as a better bearer than a plant having only one main stem. A consideration of the two kinds of plants soon shows the fallacy of so thinking. For while a plant having one main stem gives off its branches in regular order around the stem, the many-stemmed plants do so on their outer sides only, thus in the end being worse off, as while the two kinds of plants may have the same area of bearing branches at first and perhaps a slight difference in yield, in course of time the many-stemmed plant soon runs down in vigour and naturally in yield while the one stemmed plant increases both its crops and vigour with the years.

Besides removing suckers by pruning them off from the main stem, pruning also embraces the thinning out of the secondary and tertiary branches. Secondary branches are those growing out from the branches, while the tertiary ones are those growing from the secondary branches. If no thinning is done the plant becomes a tangled mass of branches which results in poor yields. By thinning out the branches light and air are allowed to circulate better in and about the plant thus inducing fruitfulness. An important rule to observe is to have the middle of your plant open by removing branches growing towards the middle or too near the middle of the plant. The main stem—all branches should grow outward and away from the main stem. Begin early in the plant's life to check undesirable growth and so direct growth in the proper directions. Neglecting to remove branches and shoots early only makes the work of pruning harder in the future with no benefit to the plant. Observant farmers must have noticed that where a fairly large shoot has been removed there springs up from around the mound made many more shoots which also require to be removed. Removal of shoots when just peeping out saves this extra work and benefits the plant by diverting sap into the branches which you want to grow and fruit

Pruning further includes removal of dead wood or dried portions of branches, while sometimes the removal of some leaves is necessary.

While it is necessary to remove suckers or shoots growing from low down the stems of healthy and vigorous-growing plants (which suckers grow in an upward direction) there are nevertheless times when a sucker serves a useful purpose, such as rejuvenating an old plant or as sometimes is necessary, a young plant that has been suffering from neglect. In such cases a sucker growing from as near to the ground as possible on the stem, is selected and trained up as a new stem and subsequent suckers arising being pruned off. In course of time such a sucker grows and branches becoming a new plant. Old Coffee plants which have run to wood and are declining in yield could be treated as above mentioned. Quicker returns are obtained by so treating worn-out plants than if seedlings were planted to form a new cultivation.

Topping:—By topping is meant the stopping of the upward growth of the central or main stem of the Coffee plant by pinching off the terminal bud at top in order to concentrate its energy into the already developed branches. Topping to be effective must be done as soon as the required height has been reached. To allow a plant to grow 20 feet high and then to cut it back to 12 feet is not a desirable way of topping as the suckers arising at the top of the plant consume much labour in checking their growth. When, however, topping is done at the height desired the terminal bud is easily removed as its growth is then soft and the head of suckers that spring up as a consequence is more easily removed Better still, disbudding is possible in the latter case. By disbudding is meant the cutting out of the buds for 4 or 5 whorls below the terminal bud at the same time as topping These buds are to be found just below the branches or whorls of branches and should be removed with some of the wood, deep enough to get out the buds entirely. When topping is done it is the buds nearest the top of the plant that shoot up, as it were, to replace the terminal bud removed, by continuing the upward growth. Therefore to make the topping effective and save time you disbud these buds and prevent their growth once for all.

As regards height at which to top there is no laid-down rule. Some people top at 4 feet while others do not top at all. As, however, observation of plants allowed to grow unrestrained shows that the plant becomes soon exhausted, topping is advisable to save the plant from itself, as it were. The writer considers a minimum height of 6 feet, and a maximum of 12 feet, about the best where high or low topping is desired. While topping increases fruitfulness it must also be remembered that the crop of a coffee plant depends on the number of bearing branches therefore the greater the number of bearing branches to a plant the greater the crop. Some people, however, prefer low plants of 6 feet height in preference to trees of 12 foot height as saving the use of cumbersome ladders. Topping at 12 feet will however, give maximum crops without seriously affecting the vigour of the plants.

Crops:—Liberian coffee arrives at its full bearing stage in from 5 to 7 years. This does not mean that no berries are borne until 5 years but rather that a full crop of berries is not borne until the tree reaches 5 years at the earliest. A few flowers, and therefore berries, will be borne sometimes as early as 2 to 3 years but not until 7 years will the tree give its best yield. An average yield of from 8 to 10 lbs is given by one plant at 7 years of age. Individual plants, however, sometimes give yields far in excess of this but this is rather the exception than the rule. And here is where the value of selection comes in. For while on a farm will be usually found many plants giving poor yields, a few plants giving average yields, and fewer still giving high yields due to non-attention to selection, a cultivation consisting of properly selected plants will give uniformly high yields; hence the advantage of selection over non-selection of plants or seed.

In gathering the crop (which starts about the latter part of November or in December, according to weather conditions, and continues on to February or March of the next year) only the properly ripe berries should be picked. A ripe berry is of a deep red colour. The

berry alone should be removed in picking, leaving the stem on the plant, or rather, the branch. This is important as if the stem is removed it reduces the next crop as is the case with Cocoa. This accounts for the reason why when ripe berries are left on the tree to dry the next year's crop is much reduced. It therefore pays to pick ripe berries from a plant, instead of leaving them to dry on the tree, as the producing powers of the plant is thus maintained. Farmers who do not pick off the ripe berries from their plants, because, they say, it does not pay at present prices, are injuring their plants and will find, should prices rise, that they have made a fatal error in not so doing.

Pulping:—Coffee berries should be put through a pulping machine as soon after picking as possible as delay in so doing makes pulping difficult. Fresh berries pulp more easily than when left over for some days. The pulping makes possible the separation of the skins from the beans by crushing the berries without injuring the beans and their parchment covering.

Fermentation and washing:—After the beans come out of the pulper they must be put up into heaps so as to allow fermentation to take place and so cause the mucilage on them to be readily removed by washing. The time allowed for fermentation is 3 days, and during this period the heaps should be regularly turned so as to equalize fermentation throughout the heaps. At the end of 3 days the fermented coffee beans are put into large boxes and subjected to running water so as to remove the mucilage on the parchment covering of the beans. For small lots of fermented beans a tub can be used by half filling it with water and putting in enough beans to allow of complete washing off of the mucilage. A hole in the bottom with a plug to stop water from running out is necessary. Should the first water not completely remove the mucilage fresh water can be added after allowing the first water to drain through the hole in the bottom of the tub by removing the plug. Rubbing between the hands hastens removal of the mucilage in washing.

Drying:—After the mucilage has been removed, by washing the beans in their parchment covers are then put out, after first draining the water from them, to dry. Wooden platforms having movable shelters over them are used for the purpose, sometimes the platforms are movable and the shelters permanent. In any case the object of drying is the same. It is necessary in spreading out the washed beans to dry, that they be thinly spread, as a more uniform drying takes place. Frequent turning during drying should be done. With the maximum number of hours of sunshine per day drying takes from 6 to 7 days, but longer, should the days be intermixed with cloudy days. To arrive at a correct idea as to whether drying is complete, the method employed is to test a few beans, after removing the parchment covers, by pressing on the bean with the thumbnail. If the nail cuts into the bean further drying is necessary; but if the thumb nail does not cut into the bean when pressed, drying is complete.

Hulling:—After drying has been completed there remains the last process of hulling, to separate the parchment covers or hulls from the beans. This is done by a hulling machine on large estates, or by pounding in a mortar on very small estates. As the hulls go one way and the beans another, the beans can at once be bagged off as they drop from the hulling machine, thus packing or bagging while hulling is in process for shipment.

A new method of treating Coffee berries:—The above process is the recognized way of preparing Coffee for the market but some years ago a new method was tried in Pomeroon and proved so successful as to be now the fashionable method. It differs from the recognized method in that washing is eliminated. The pulped Coffee after being fermented is spread out on the drying platforms straightaway. Drying, however, in this case, takes 3 days more, as the mucilage is not washed off. When drying is complete, hulling is done as before and the hulled product put into bags for shipment. It may be mentioned incidentally that a standard bag of Coffee contains 200 lbs of cured beans. An advantage, to the

farmer of the latter process is that the cured product is heavier in weight than when prepared according to the formed method. The Coffee drinker has also the advantage of an improved aroma, approximating that obtained from berries allowed to ripen and dry on the trees. No doubt the mucilage which probably is absorbed by the beans in drying is accountable for the improved aroma.

Pests:—Fortunately there are a few pests but no disease that trouble Liberian Coffee plants in this Colony:—(1) Scale insects are sometimes found on the plants but only in a mild form. (2) Bird-vines are, however, exceedingly troublesome, if left unrestrained, and kill the plants when so left. The farmer who, however, prides himself as a farmer will see to it that bird-vines do not get a foot hold on his plants by removing them as soon as seen. (3) Black ants are sometimes a nuisance to pickers but they are only present to an appreciable extent where weeding and keeping the plants free from vines and other undergrowth have been neglected, as also where pruning is conspicuous by its absence.

AGRICULTURAL NOTES.

Rice And Its Risks.

An interesting extract from the Journal of the Board of Agriculture, Vol. 2, No. 4, April, 1909. We have appended some figures relative to the acreage under rice, sugar and other products in British Guiana during recent years which indicate that rice, despite a number of vicissitudes, still continues to flourish and somewhat more than hold its own in competition with other crops.

Enthusiasm is an excellent thing—even a very excellent thing—but it should be tempered with judgment. No one will deny the present importance to the colony of the rice industry or fail to give due credit to

the enterprise, energy and independence of its pioneers. Within a short space of years they have developed the resources of the colony in an unexpected direction and to a phenomenal extent. They have left a permanent mark on its history and enlarged its prospects: and that without any aid but that afforded by a series of congenial seasons and favourable markets. Unfortunately the "but" is a big one; and those who do not wish to live in a fool's paradise must face the facts that seasons may change and markets fluctuate. In that case, what will become of the rice industry?

The risks which the growing of rice in British Guiana involves are patent, and have already been dwelt upon at commendable length and with praiseworthy persistence by the daily Press of the colony. It is on record that the industry on the Corentyne Coast was virtually extinguished by drought in 1899. It is admitted that the question of irrigation is vital and pressing. The effects that must follow a considerable fall in the market price have been less emphasized, but are none the less important. India is a factor in the problem which must never be lost sight of. although various circumstances of late years—years concurrent with the rise of rice in British Guiana —have combined to eliminate the influence of the great Eastern Dependency. With India once again famine-free and able to export the cereal in normal quantity, what, we repeat, would become of our rice industry?

The question, if disconcerting, is appropriate enough in view of an undeniable waning of interest in provision growing, This unfortunate tendency is unmistakably indicated. The reports of the Department of Science and Agriculture leave little doubt on the matter. Before us lie the results of the Farmers' Competition on the East Coast, held under the auspices of the Buxton Farming Association, and the comments thereon of the Director and the members of the Exhibition and Subsidiary Products Committee. From these it is evident that the enthusiasm in agricultural matters aroused among the farmers during recent years has either dim-

inished or been transferred to the cultivation of rice—with all its risks. In other words the local "small man" is taking the perilous course of putting all his eggs into one basket, and that a receptacle which it is admitted may give way at any moment. It is true that a great American humorist has altered the ancient proverb to read: "Put all your eggs in one basket—"*and watch the basket*," but however suitable that emendation may be to business or Yankee finance, it would be fatal if applied to farming. There is much that the skilful and scientific agriculturists can influence—soil, drainage, supply—but the fundamental conditions under which he works—climate and seasons, sunshine and rainfall—are beyond his control. Even the incidence of disease and the appearance of insect pests cannot be anticipated in most cases, and he is indeed a foolish man who exposes himself to the danger of having the whole of his means of subsistence destroyed at one fell swoop. By cultivating a variety of crops the wise man insures himself against disaster. Conditions that may be adverse to one crop are often eminently suitable to another. Diseases that attack one plant pass another by. Pests are frequently nice in their appetite. There seems no reason why the fashion or rice-growing should imply the neglect or abandonment of other and safer cultivations. Rather the opposite. Common sense and experience both argue the other way, and we would not be behind hand with our warning. We are mindful of the fact that agriculture is a business; that farmers naturally look for their profit where they can most easily find it; and that provision growing is subject to certain disadvantages, of which praedial larceny is not the least. Yet for this last, at any rate, the remedy is largely in the hands of the villagers themselves. If public opinion in the country districts was seriously and unmistakably against the provision thief, the hands of the Government would be immensely strengthened. The law can provide "catting" for the culprit when caught and convicted; and energetic public spirit, by organizing vigilant societies or what not, would see to it that he was caught.

The paralyzing effect of praedial larceny on industry and thrift justifies the strongest measures, but its occurrence cannot be put forward as a valid excuse for so modifying the choice of cultivation as to expose great portions of the colony to the risk of grave disaster. We have no desire to see an Indian famine repeated here on even a small scale; yet the failure of the rice crop might mean all that if the present tendency be not stopped. And, as usual, it would be the poorer classes who would be the chief sufferers. We would do nothing to check enthusiasm; but we would seriously warn the farmers of the colony to make sure that their enthusiasm does not lead them to neglect precautions which their sober judgment must suggest.

	Acres under Sugar Cultivation.	Acres under Rice Cultivation.	Acres under other Products.	Total area under Cultivation.
1908	74,865	39,746	33,356	147,967
1913	72,898	35,582	43,832	152,072
1914	73,108	47,037	49,389	169,534
1915	75,744	50,737	49,888	176,369
1916	78,346	57,022	51,117	186,485
1917	77,828	58,090	55,762	191,680
1918	73,565	60,432	63,890	197,887
1919	70,876	61,400	58,341	190.717

Power Alcohol From Rice Straw.

According to an article in *Nature*, October 21, 1920, dealing with possible new sources of power alcohol, an interesting recent proposal has been made. This is, that alcohol for industrial purposes may be obtained from rice straw and husks, a cheap raw material available in large quantities in rice-growing countries. The process proposed is to soften the straw by steaming; it is then treated with hydrochloric acid, or with calcium hypochlorite and chlorine, to disintegrate the fibres; it is then pulped, and

the hydrolysis of the cellulose and starchy matter completed by means of diluted hydrochloric acid. After the conversion of the sugar takes place, the acid is neutralized, and the solution of sugars fermented and distilled. It is stated that arrangements have been made for large scale experimental trials of this process in India, with the view of ascertaining whether the production of fuel alcohol from these and similar cheap cellulose materials can be definitely established.

Experiments are also in progress to ascertain whether a micro-organism can be obtained, which will effect the direct conversion of cellulose into fermentable sugar. Success on the lines of this or the preceding process would open up the prospects of utilizing a large amount of waste cellulose substances as sources of industrial alcohol.

Losses in Harvesting Burnt Cane.

The opening of the crop season with its attendant period of prevalence of cane fires raises the interest of planters in the question of the deterioration of canes that have been burnt. Recently J. A. Verret has recorded data from an experiment carried out at Ewa plantation, Hawaii, on a special field of first ratoon canes on the 1920 crop. The object of the experiment was to determine the losses which take place in handling canes from large accidental or incendiary fires. The following summary is abstracted from an account of Verret's work as published in the *Louisiana Planter* for January 15, 1921.

A uniform field of about 3 acres of canes was selected and divided into twelve areas, each of which was subdivided into four plots, 'A,' 'B,' 'C', and 'D'. The 'A' plots were harvested immediately after burning, the 'B' plots five days later, the 'C' plots ten days, and the 'D' plots fifteen days after burning.

Whenever burnt cane was harvested, corresponding areas of unburnt cane from an adjacent strip of land were also harvested, to serve as a check on the results. All the canes in half of the burnt field were allowed to stand until harvested at the times mentioned. The canes in the other half of the field were at once cut down after burning, and allowed to lie on the ground until harvested. The harvested canes were weighed and then milled, and the composition of the expressed juice estimated by ordinary analytical methods.

The following results were obtained:—

1. Cane harvested within a few hours after the fire showed no loss due to burning. The heat generated by the fire destroyed a quantity of sugar, so small that it could not be detected in the laboratory.

2. Burnt cane allowed to stand and tested after five days, was found to have lost 6·57 per cent of its weight, and 15·23 per cent. of its sacrose. If cut immediately after burning and left on the field, the losses at the end of five days were 15·30 and 14·22 per cent. respectively.

3. At the end of ten days the losses were, for standing cane, 11·39 per cent. of cane and 29·23 per cent. of sugar; for cut cane, 22·45 per cent. of cane and 30 26 per cent. of sugar.

4. At the end of fifteen days the losses were, for standing cane, 20·89 per cent. of cane and 51·66 per cent. of sugar, and 29·18 per cent. of cane and 48·80 per cent. of sugar for cut cane.

The result is somewhat unexpected, for the figures show that after the cane was burnt, it made no appreciable difference in the loss of sugar whether the cane was allowed to stand, or was cut. So that there is no advantage when reaping a crop of burnt canes, to hold back the cutting so as to keep pace with the loading and carting. Indeed there is an advantage in immediate cutting, since there is less weight to handle in reaping long-cut canes than in reaping canes that have only just been cut.

5. When burnt cane is allowed to stand the density of the juice tends slightly to decrease, but when cut at once, there is a decided increase in density of the juice. In the experiment described the increase was from 18·6 to 22·1 Brix degrees in fifteen days.

6. The quotient of purity of juice of burnt cane, whether standing or cut, was depressed at about the same rate.

7. The number of tons of cane needed to make one ton of sugar was greater for standing burnt cane than for cut burnt cane So that cutting is advantageous from the manufacturer's point of view.

It would appear advisable, therefore, after a cane fire, to cut the canes at once and follow up the loading and carting at a rate decided by the capacity of the transport vehicles used.

How To Keep Seed Corn.

The following simple method of treating corn against infestation, may interest growers in places where there are no corn-granary facilities. The extract is taken from Circular No. 18, Porto Rico Experiment Station, on the selection of seed corn in Porto Rico:—

Among the great many samples of corn received in this office during the last eighteen months, none was in better condition than those which had been dried in the kitchen and subjected to smoke from the charcoal stoves. This is a thoroughly practical method, and should be more widely applied, but is now used to only a limited extent. In most places it would be not at all practical to turn the kitchen into a corn-drying establishment, yet anyone can dry and smoke a large number of ears in a home-made contrivance.

'For this purpose use two barrels, after knocking the heads out of both; also a box which must be slightly longer and wider than the diameter of the barrels, and from 12 to 18 inches in depth. After removing the

cover of the box, cut a hole slightly smaller than the diameter of the barrels in the bottom, then another hole about 12 inches square in one side of the box close to the top. Place the box, bottom up on the ground, with one of the barrels on the top, covering the hole previously made. Put the second barrel on top of the first one, and secure the two in an upright position with braces. Now place a charcoal burner in the box, using for fuel, charcoal with corn cobs and other such material as will produce considerable smoke without blaze.

'Hang in the upper barrel the ears of corn which have been tied in a long string by a series of slip knots and suspended from stout sticks laid across the top. The drying and smoking process should be continued for about a week, care being taken never to let the fire blaze. A temperature of 135° F. is perfectly safe, but 145° F. may cause some injury. The germ in all the kernels will be killed by a temperature above 160° F. continued for any length of time.

'After the ears have been well dried in this manner, all insect eggs will be killed, the smoky condition acting as a repellent against further infestation. As indicated below, the ears may then be packed in a tight barrel or box. On the bottom of the barrel place about 2 inches of air-slaked lime, next a layer of ears, filling in the spaces between the ears with lime. When this container has been filled in this manner, finish with a few inches of lime to cover the upper layer of corn. Packed in this way, corn may be kept perfectly safe from one seaon to another, the lime absorbing surplus moisture, and preventing weevil from entering.

A FISH EPISODE.

Mr. A. L. Hager, general manager of the New England Fish Company, Vancouver, who has always shown great interest in having his employees look out for rare specimens for the Museum, and through whose efforts several species have been added to the Provincial Museum collection, wrote to the Director on February 11th, "that Mr. Walter White, for many years employed as a halibut-fisherman on the vessels of the New England Fish Company, and latterly as mate on the S.S. 'Kingsway,' brought to their office a rock weighing about 2½ lb. Mr. White states that he personally took this rock from the stomach of a halibut weighing about 60 lb. The S.S. 'Kingsway," was fishing off Bonilla Island at the time in about 35 fathoms of water. It occurred to us that you might like to receive and preserve this rock."

This rock was eventually sent to the Provincial Museum by Mr. Hager. Later I sent a copy of the letter, as requested by Mr. Hager, to Mr. Will F. Thompson, Assistant in charge of the Long Laboratory, California, for his information.

Mr. Thompson is a well-known fish expert on the halibut fishes, and has done considerable scientific research-work in the Northern British Columbia halibut waters. In reply, Mr. Thompson writes as follows:—

"Many thanks for your letter with the copy of the note on the rock swallowed by the halibut. It is perfectly possible. The halibut are famous eaters of small things, and they pick from the ground, rocks, etc., and all sorts of things, including sea-anemones, clam-siphons, etc., and in the process of doing so they frequently take in many things which are not intended to find a lodging in the stomach of fish The famous stones which the cod takes in (as ballast) in storms are the results that follow too reckless eating on the part of the cod. The size of the stone, however, is a most surprising thing. It bears witness to the reckless habits of the halibut."

—*Report of the Provincial Museum of Natural History. British Columbia, 1919.*

PORT MOURANT-ROSE HALL FARMING ASSOCIATION.

The President and Officers,
B. G. Farmers' Conference,
Gentlemen,

I have the honour to submit a report on the work of the Port Mourant-Rose Hall Farming Association for the year ending 31st December, 1920. The event of chief interest and importance which has taken place in our district was the meeting of the Fifth Annual Conference in April last year, an event which has been fraught with vital results.

The Executive Committee have assisted in the establishment of two farming associations—one in the Bloomfield-Manchester district, and the other at Kildonan. The absorbing topic of the day is the extension of the Cane farming industry. Series of meetings have been held in connection with this matter, and our members cannot adequately express their satisfaction and pride of the spirit and ardour of the Revd. E. R. O. Robertson, who has taken such a deep interest in our welfare. We beg to commend him for the thoroughness in which he performs any work entrusted to him.

A loan of $6,500 was negotiated with Messrs. Curtis Campbell and Company for the purpose of empoldering and planting 61½ acres with canes in the provision section of Rose Hall Village.

A Sub-Committee was formed for the purpose of formulating a scheme in which they were ably assisted by W. H. Watson, Esq , Deputy Manager of Pln. Albion. As our Association is not a corporate body, it was decided that the Local Authority should be their sureties.

The scheme was submitted, and the estimate approved, except the item with regard to planting—

which the Inspector of Districts stated should be undertaken by the Loan Bank—a proposal which was rejected by the cane farmers.

No further development has taken place, so the scheme is in abeyance.

We are pleased to record our sincerest thanks to the Manager of Pln. Albion—Jas. Bee, Esq.,—for his kindness in issuing temporary loans to cane farmers to assist them in the cultivation of their crops.

Loans amounting to about $600 were given, and the farmers made prompt repayment.

The crop was reaped in the month of October. Payment was made on a basis of $43.57 per punt loaded to a depth of 10 inches.

We deeply deplore the resignation of our President, C. A. Birtles, Esq., who has been compelled to relinquish office on account of his departure from the district. During the tenure of his office for two years, he has rendered very valuable services to the Association. Being a planter, his intimate knowledge of cane farming has been of considerable value to us. We beg to express our deep appreciation of his advice and the help he has rendered to the Association from its inception.

We have to refer also to the loss sustained by the transference of the Revd. T. Wilkes, Treasurer and founder of the Association—to the Parish in the Canje District. He took a deep interest in the welfare of the people, and always endeavoured to foster the spirit of co-operation.

Thirty four members were admitted during the year. The receipts were $58.70 the balance carried forward from 1919 was $40.62 making a total of $99.32. The expenditure amounted to $48.76, leaving a balance of $50.56.

Wm. W. F. Sullivan,
Hon. Secy.

26/3/21.

BOTANICAL, PLANT DISEASES AND PEST NOTES.

WATER HYACINTH: A PEST.

One of the most beautiful flowering aquatic plants is known as the water hyacinth (*Eichornia crassipes*), which has become, however, a serious menace to navigation in the rivers of Florida. It may be mentioned that another species of the same genus, *E. azurea*, is highly prized as an ornamental plant for growing in ponds or tubs in the West Indies. This species, however, is not as vigorous in growth as its congener, and would not be so likely to become a pest.

How the plant became established in Florida is not exactly known, but it seems to have been introduced as an ornamental aquatic, and to have been first planted in a pond, where it soon became so abundant as to necessitate control, and it was taken up and thrown into the St. John's River.

In addition to its interfering with navigation, the spread of the water hyacinth in the St. John's River and its tributaries caused at one time considerable loss in the value of the timber floated down that stream. Moreover, the rank decaying vegetation is a menace to sanitation, as it not only affords a shelter and breeding place for disease-carrying insects, but interferes with the disposal of sewage.

The story of this plant in Florida affords a striking illustration of the danger of inconsiderate introduction of plants from one region to another.

The following account of the campaign for the eradication of the water hyacinth from the streams of the Southern States is taken from an article in the *California Monthly Journal*, March, 1920, which also contains a warning as to the danger of introducing the plant into the rivers of that State.

The water hyacinth has now become so abundant in Florida, Louisiana, and Texas as to obstruct navigation in the

waters emptying into the Gulf of Mexico. Its eradication was entrusted in 1899 to the United States Engineer's Office of the Water Department. From that time the Engineer Office has worked continuously on eradication, and has spent hundreds of thousands of dollars in attempting to remove it from navigable streams.

No method has ever been found which will completely remove the plant at a reasonable cost, but the solution which has been found most effective is an arsenical spray.

The water hyacinth is eaten with relish by stock, and in Florida its use as a feed has become so well established that it was considered necessary, in making an appropriation by the Rivers and Harbours Act of 1905 for the removal of the plant from the St. John's River and other navigable streams of Florida, to insert a proviso that "no chemcial process be used injurious to cattle." It was at first attempted to break up the masses of the plant and push the pieces into the current, but this was found unsatisfactory, and exceedingly expensive. Since 1909 an elevator fixed to a barge has been used, which gathers the plant in much the same way as kelp is gathered. Fixed booms are maintained across non-navigable streams to prevent the floating into navigable streams, and movable and semi-automatic booms to prevent its floating from one navigable stream into another. Labourers and watchmen are employed to detect or prevent the spread of the plant.

In the other Gulf States, the use of chemicals is not prohibited, and although difficulties are encountered by owners of stock along the streams allowing their animals to eat the sprayed plant, with fatal results following, local co-operation is generally obtained in combating the pests.

In Louisiana two barges, propelled by gasolene launches, and equipped with tanks for mixing, and pumps for spraying the chemical solution, are kept continually in service from about April 1 to December 1 each year.—*Agricultural News.*

THE KURUA PALM.

On pages 172-174 of Vol. XVIII. No. 2 Bulletin of the Imperial Institute for April-June, 1920 there appears a report on oil made from the Kurua (Curua) palm (*Attalea spectabilis* Mart.) the fruit being sent from Brazil.

The "Kurua" palm is mentioned in a report dated 1879 by the late Government Botanist, G. S. Jenman as occurring on the Courantyne River from Epira upwards, and by Chas. Barrington Brown in "Canoe and Camp Life in B.G." on the upper Courantyne and New Rivers. It is to be found in the Berbice River, to my knowledge in the vicinity of Wikki and upwards and at various places between Berbice and Demerara Rivers inspected during the Cattle Trail Survey. I understand it is also to be found along the upper Essequibo River and in Rupununi District.

In comparing the results of the Examinations of Kurua fruit with those of Kokerit from this Colony (Vide report on pp. 8-13 of Vol. XIV. No. 1 of 1916) it is seen that the yields are somewhat similar as shown hereunder:—

(a) Per cent. of yield from whole fruit:—

Pericarp	Kurua	15.5	Kokerit	17.0
Pericarp oil	"	2.9	"	2.6
Kernels	"	13.2	"	17.0
Kernel oil	"	(not stated)		9,7

(b) Per cent. of yield of oil from the dry kernels:—

Kurua	65.3	Kokerit	64.1

The "fat" or oil from the pericarp of Kurua was of greenish colour and semi-solid, while that from Kokerit was orange-red and semi-solid. The fat from the kernels in each case was, respectively, "a soft pale cream-coloured solid" and a fairly hard, "cream-coloured fat"; both are stated to be edible oils.

The chemical analyses of the kernel oils and the meal cakes are also very similar.

It was stated that Kurua kernels should realise a higher price than oil palm kernels and the latter was quoted in July, 1920 @ £31 per ton in the United Kingdom, while it was stated that Kokerit kernels should fetch the same price as palm kernels or possibly a little more, the price of the latter being quoted in May, 1916 as £20. 5s. in Liverpool.

L. S. HOHENKERK.

19.3.21.

LOCUSTS IN ASIATIC TURKEY.

The Union Department of Agriculture of South Africa has carried out some extensive campaigns against locusts, but its work seems small in comparison with work carried out against locusts under German supervision in parts of Asiatic Turkey during the war. A German publication reviewed in a recent issue of *Review of Applied Entomology*, states that in 1915 Anatolia, Syria, and Palestine suffered greatly from locusts. An anti-locust campaign was then organised, with a staff of 14 directors, 72 officers, 2,000 supervisors, and about 11,000 men from labour battalions and compulsory levies from the population. An average of 450,000 to 500,000 workers, it is stated were employed daily from March to May, 1916 in western Anatolia, and 6,000 tons of locust eggs and 11,000 tons of locusts were actually collected. The barrier and pit system of trapping was the chief measure used against the voetgangers. Poisoning was also resorted to with success, but no practical results were obtained with fungoid and bacterial diseases. For work in the following season 250 non-commisioned officers and 2,500 men were detailed as instructors, while provision was made for the supply of about 300 miles of zinc strips to serve as barriers and 50 tons of arsenic and paris green for use in preparing poison baits.—*Journal of the Department of Agriculture, South Africa.*

To Keep Cut Flowers Fresh.

It may be of interest to readers of the *Agricultural News* to know that, in most instances, cut flowers for use in vases and bowls in the house will last much longer if the stems are cut under water. The flowers cut in the garden are brought into the house, and when they are being arranged, the ends of the stalks are trimmed afresh, a neat, clean cut being made with a sharp knife or scissors actually under water in a bowl or basin, or in the running water under a tap.

The object of this proceeding is to prevent the searing over of the cut surface, which results if the air comes in contact with it. If the cut is made under water, a film of moisture forms on the cut surface and the air does not come in contact with the several tissues.

This method is beneficial in dealing with a wide range of flowers, from gaillardia, calliopsis and begonia, as examples of soft tissues, to bougainvilaea, allamanda, and other very woody-stemmed plants, as well as roses, snapdragons, and others with moderately hard stems.—*Agricultural News.*

IMPRESSIONS OF THE B. G. FARMERS' CONFERENCE.

By Rev. W. A. Deane.

The sixth Annual Conference of the British Guiana Associated District Agricultural Societies held at the Congregational school-room, Beterverwagting, East Coast, Demerara, on 5th and 6th April, 1921, was a record-breaking one.

Those actually engaged in the production of canes, rice and other commodities for consumption in, and export from, the Colony were well represented; the number being about one hundred.

The most striking feature of the Conference was the goodly number of young men of brains and training of the African and East Indian races identified with "the tilling of the soil" than which, after all, there is no nobler or more independent calling; the conclusion drawn is, therefore, that dignity to agricultural labour in our agricultural country, has, at last, taken deep root now, which is due to agriculture having formed part of the curriculum of our Government Elementary Schools. This change began about twenty years ago.

It is due in part, also, to the stimulus given to agriculture by the timely birth and healthy existence of the B. G. Farmers' Conference; to the Board of Agriculture, to the Department of Science and Agriculture under the directorship of the Hon. Professor Harrison, C.M.G., M.A.

Added to the above persons, the Rev. F. Denny and Mr. H. Aaron Britton, the newly elected President of the Conference and one of the best, if not the best young leaders of the people, the Rev Eric R. O. Robertson, who, I might say has "kingdoms in his pulses and empires in his brains."

Discussions on cane farming were acute and well-measured; the basis of payment of farmers' canes by the Sugar Planters' Association having very nearly reached the stage of satisfaction or settlement.

The element of distrust between the farmers and planters will have been destroyed as soon as that further compromise is conceded by the Planters' Association, most of whom are worthy of admiration and high esteem for their "much give and take" policy.

That executive members of the Conference, it was decided, should reply to the matter from the Planters' Association importunately requesting that the option to take sugar or money should be with the cane farmers and that a little more consideration for the payment of canes should be allowed them.

The further growth of the cane-farming industry only recently begun on the West Coast of Demerara on estate lands given on good conditions by Messrs R. Strang and G. E. Anderson will be a matter of fact when the misunderstanding is removed.

The gloom over the Conference was the regrettable absence owing to illness of the Rev. J. F. Denny who as a chief founder of the Conference was deservedly eulogised for his invaluable services; sincere sympathy being expressed in a resolution to him with a wish for his speedy recovery.

The most popular people's man, the Hon. R. E. Brassington, M.C.P., Mr. R. Montgomery Parker and Hon. Prof. J. B. Harrison could not attend the Conference owing to unforeseen circumstances but their earned admiration was intense.

Iirrgation and Drainage Scheme was the slogan of the Conference.

This recurrent and burning question received its fair quota of consideration. If anything more than another is needed to further agricultural interests in our "Magnificent Province." it is Irrigation and Drainage, which should be a Colonial question for the ultimate establishment of a thriving peasantry.

It does not need my pen to describe the devastation and ruin as well as the discouragement to farmers consequent on the annual inundations and droughts.

It would be well if the Planters' Association could join forces with the Government and cause "Irrigation and Drainage" to enter soon into the realm of practicability. This colony needs more than four times its present population as it needs badly "Irrigation and Drainage," more factories and other openings of employment which are concomitants of a prosperous Government and a thriving peasantry.

The Hon. J. S. McArthur, M.C.P. and Mr. J. A. Luckhoo, F.R., honoured themselves and encouraged the Conference with their presence.

The ubiquitous Editor-manager of the Daily Chronicle, too, took active part at the Conference.

The British Guiana Teachers' Association was represented by Messrs. H. D. Durant and H. Bunyan, President and Vice-President, respectively.

A great impression made by the Conference was that it had justified its existence and had accomplished much. On the whole, the questions and motions were timely, showing the great interest farmers had taken in Agriculture, which is a happy innovation.

The Education Department, the Department of Science and Agriculture, the Government, orginators of Agricultural shows in this Colony, the Schoolmasters, who readily took the first Agricultural lectures and passed examinations, years ago, must have had jubilant reminiscences as their dreams and visions, etc., are now realities.

Let everyone, therefore, be inspired with greater faith, refusing to be in the class of pessimists. In the near or distant future our native country I believe will bloom forth greater things.

Attracted "Labour and More Money;" Brains and General Prosperity would fraternise with one another.

Then the exodus of some of the people would give "the right of way" to free immigration automatically and the name, "Magnificent Province" would not be a misnomer.

The Conference was both educative and interesting. It is destined to be a more powerful factor under the aegis of the Government for the fostering of Agriculture in an Agricultural Colony. It is suicidal, therefore for any self-respecting farmer and patriot, at this stage, to withhold his or her connexion from the Conference.

Rural pedagogues formed a prominent part in the Conference which augurs much for further success.

Conspicuous among the visitors were the Rev. H. W. Grant and Persaud, ministers of religion. All ministers of religion should be in some form or other interested in Colonial Agriculture.

Mr. H. Aaron Britton, who is also one of the principal founders of the Conference and well-known for his ability, is now elevated to the presidency of it. We

believe that with his mature experience and with the co-operation of the Conference Mr. Britton ought to do something more during his regime.

The Rev. Carlyle Miller of Victoria, East Coast, Demerara, read a very good "Conference Paper" entitled "The Signs of the Times."

Beterverwagting cane farmers and others must be congratulated for their clean village and for their hospitality. The unity and the good training of the schoolmasters at Beterverwagting must be commended.

It was unanimously decided that the next Conference be held at Hague, West Coast, Demerara.

Although unequal to the task I have obeyed the order to write, at the shortest possible notice, my impressions of the Conference.

THE BRITISH GUIANA FARMERS' CONFERENCE.

By R. Reuben Baird.

The Sixth Annual Conference of the British Guiana Associated District Agricultural Societies, held at Beterverwagting Village, on the 5th and 6th April, 1921, is now an event of the past. Unlike other events of the kind, however, and to this all the leading organs of thought seem to ungrudgingly subscribe—it would not end in smoke, but rather would make its influence felt not only in the development of the civil, economic and industrial stability of the Colony of to-day, but also that of to-morrow.

As one writes, one begs the memory to recall instances in which men recruited principally from the masses of the people of this colony, met, and almost with sacred ardour, evinced such grim determination and keenness in, and discussed with such foresight, unselfishness and statesmanship, questions affecting the colony as a whole.

There were debates; there were speeches; there were papers; there were reports; but all seemed to have relegated to the inglorious past, the gloss, the embellishments, which, at one and at the same time won applauses, but failed to make impressions; and to have served up, unceremoniously, the bald facts, the undressed conditions, such as they exist in our communal life. In short, business definiteness, something concrete, something achieved seemed to have dominated, seemed to have sufficed the being of every delegate. If the motions, if the debates, coupled with the Spirit of the delegates must be regarded—and there is no reason to think otherwise—as indicative of the feeling of the farmers all over the colony, then it cannot but be taken for granted that they are realising the power of combination, they are feeling the want of, and are appreciating the necessity for more organised agricultural education; they are learning the Gospel of Self-help; they are becoming more conscious of the fact that if the agricultural resources of this colony must be developed, if an independent peasant proprietary must be a reality, if this colony must function in Imperial interests, then they must depend not only upon the Government, but also, and more so upon themselves.

Held at a time when the staple industries of the colony are passing through perilous times, when the question of Drainage and Irrigation seem to be the Slogan of the day; when the General Election is drawing near, it was necessary for this Conferenee to make its contribution to these great issues. Little wonder then, that due prominence was given to them.

The question of Cane-farming was discussed in all its phases. The Farmers' cards will, in due course, be laid on the table by those appointed so to do. But in passing, one is inclined to say that it seems as if the Planters will have a case to answer.

While *sympathy* was given to those who had suffered as a result of the present regulations concerning the exportation of rice, something tangible, something concrete

was held out to those who had suffered as a result of lack of an irrigation scheme. Almost unanimous was the opinion that nothing but increased production during the current year could justify exportation, and to that end was the co-operation of all enlisted. But is it not time that increased production is dependent upon IRRIGATION not to speak of DRAINAGE ? Great, therefore, was the emphasis laid upon this all-important question.

With guarded care were the slippery paths of Politics eschewed. Every flame fanned in that direction was quickly smothered. Yet, it was none the less evident that there was the veiled suggestion that it is the intention of the Conference to manifest more than ordinary interest in the forthcoming Election.

The interest manifested by all classes of the community calls for more than passing notice. A brilliant array of young men lent lustre to the proceedings, and the opinion was unhesitatingly expressed that there is still a bright future for Agriculture.

From all that one was privileged to observe one was compelled to concede that this Organisation is truly the farmers' mouthpiece, and whatever is said and done it must be admitted that from its inception it has been functioning in the interests of farmers, and that it is destined to play an important part in the development of this colony.

The office-bearers for the current year are chiefly young men and coupled with this, a new spirit, a progressive policy has been evinced, has been mapped out, there is, therefore every hope for a successful year, for a future productive of results for the general good.

SOME INSECT PESTS OF BRITISH GUIANA.

BY G. E. BODKIN, B.A., DIPL. AGRIC (Cantab), F.Z.S., F.E.S.,

Assistant Director and Government Economic Biologist, Department of Science and Agriculture, British Guiana.

(The paper read by British Guiana's Official delegate to the Imperial Entomological Conference in London, June, 1920.)

British Guiana is the sole British possession in the whole, vast South American Continent and has an area of 90,000 square miles, or, is approximately, the size of Great Britain. It has a population of some 300,000 people.

It is divided, roughly into 3 belts; the coastal region is flat—practically a belt of marine alluvium; then a belt of slightly more elevated country consisting of sandy and clayey soils and finally the immense forest areas containing mountain ranges. The eastern portion of this is almost entirely forest clad, but on the north western side there is an extensive area of flat, grass-clad, savannah-land some 300 feet above sea level.

There is a mean annual rainfall of some 94 inches and the average, mean shade temperature is somewhere round 80 degrees F.

As British Guiana's principal agricultural product is sugar, I propose to confine what I have to say mostly to the insect pests of sugar cane and the local methods of control.

There are in the colony to-day, some 36 sugar estates in active operation producing annually some 114,000 tons of sugar, 3,416,000 gallons of spirits and rum, 150,000 gallons of molasses and 2,400 tons of molascuit, the well known cattle food.

Given an adequate labour supply these returns could be vastly augmented.

Insect pests of sugar-cane have been recognized in British Guiana for at least the last quarter of a century, but it is only during more recent years that they have received any serious attention or combined efforts been made for their control.

To-day the injury and financial losses caused by such insects is fully realized, and the control of insect pests on a sugar estate in British Guiana is now a regular part of the routine.

Owing to the somewhat peculiar conditions of cropping which are closely connected with the marketing of the product, cane at various stages of growth is to be found throughout the year, there being no recognised regular harvest. This renders the control of pests a particularly difficult matter, for as one area is cut these insects simply migrate to another adjoining area in a younger stage of growth.

The most injurious pests are those known collectively as "borers," which consists of three species of lepidopterous larvae, namely, *Castnia licus*, Fab., a member of the exotic family Castniiadae, which is popularly called the giant moth borer, *Diatraea saccharalis*, F., a member of the Pyralidae, and well known in most sugar-growing areas of the world, which is termed locally the small moth borer, and *D. canella*, Hamps., which is much like *D. saccharalis* in all its stages.

These three pests pass their larval and pupal periods within the cane itself, thus weakening it and causing a material deterioration in the juice. Their attacks are often followed by a complete destruction by Termites or wood ants, whose function in the insect world is to entirely demolish all decaying or diseased vegetable matter.

The Giant Moth Borer.

The giant moth borer confines its attack more to the stool or rooting system of the cane. It is a comparatively recent pest, as it appears to have been uknnown twenty

years ago. Since its first appearance it has multiplied at an exceedingly rapid rate, and during 1919 on 16 estates 91,479 moths were destroyed and 1,600,046 larvae.

Like many of the injurious insects in this part of Tropical America, Castnia has invaded the cultivated areas from the forest region, the original habitat of its larva being either orchids or the roots of wild plantains. It will also breed in the roots of cultivated plantains and bananas. The larva attains a length of 2 to 2½ in. No known true parasites of this pest have ever been discovered, This is due to the concealed habit of the larva and chrysalis, which is often some considerable distance beneath the surface of the soil, and the eggs are deposited in the most haphazard manner by the female moth, never being laid in any particular spot, but dropped one or two at a time about the cane plants. This, of course, excludes the possibility of egg parasites. Birds are the most important enemies of Castnia, especially the so-called kiskadee (*Pitangus sulphuratus*) and the old witch (*Crotophaga àni,*) both of which are particularly fond of the adult moth. On all sugar estates organized gangs, principally composed of native-born East Indian children (known as Creoles), are employed in the destruction of this pest. The gangs vary in size from thirty to as many as 100 individuals on some estates. These children have grown remarkably astute at this work, and many of them now earn comparatively large sums of money.

The most effective control method employed is to send a gang of these children through a field of canes that has recently been cut. They search the roots of the cane for traces of the borer, and wherever frass or an open boring is observed in the stumps a long hooked wire is introduced therein, and after some manipulation the larva, if present, is impaled and dragged to the surface. If this is not successful, the stump is partially dug up and the larva, or chrysalis thus secured. This method gives excellent results The caterpillars and chrysalides are kept by each individual in an old tobacco tin, and at the end of the day the contents are arefully counted and checked. A half-penny apiece

is paid for the caterpillars or chrysalides when they are scarce, but the price fluctuates. Boys provided with nets are also employed to catch the adult moths. A higher price is paid for the moths, which only fly during certain parts of the day.

The Small Moth Borer.

The small moth borer has been known in the cane fields for many years, and much has been written concerning its life-history and habits. This small insect has received considerable attention in Louisiana, where it has become a serious pest. It is capable of completing its life-history in other plants than cane, such as several species of grasses and Indian corn.

It confines its attacks more to the cane itself, and more especially during the first three months of the plant's existence.

The eggs are deposited by the female moth on the young leaves as soon as they appear, and the resulting larva bores its way gradually down into the centre of the plant, thus destroying the growing point and causing the central shoot to wither and die.

Older canes, especially those with a hard epidermis, are not so frequently attacked owing to the difficulty of gaining an entrance to the cane.

This pest is principally destroyed by the method popularly known as cutting out.

Gangs of East Indian children are sent through the fields of young cane, and wherever a dead central shoot is observed it is cut off close to the ground, split open, and the contained larva or chrysalis secured and placed in a tin. A fair price per hundred is generally paid for the grubs and chrysalides, though this price, of course, fluctuates according to the abundance of the pest. Three hundred are sometimes collected by one individual during the day. Cutting out cannot be employed after the canes are four months of age.

During 1919, 22,779,354 caterpillars and chrysalides were thus destroyed, The collection of the egg masses of

this pest is now performed on most estates. The eggs are light yellow in colour, oval in shape, and are deposited overlapping one another in the mass. Though somewhat difficult to discern at first, with practice it is possible to collect quite a fair number during the course of the day. A small gang of specially trained children are employed in the work, and are well paid.

Two species of egg parasites of the small moth borer are commonly met with, and one *Trichogramma minutum*. Riley, has a world-wide reputation, as it is known to parasitize the ova of many species of Lepidoptera in many parts of the world.

Several species of external Hymenopterous parasites occur, one Dipterous parasite, and a fungus parasite, a species of *Cordyceps*. The larva of an Elaterid beetle also preys on the early stages.

These parasites, especially the egg parasites. perform excellent work in the control of this pest, and lines of work have recently been commenced with a view to increasing, if possible, their utility.

Other Pests.

Other more important pests include the so-called weevil borer (*Metamasius hemipterus*,) which at times damages the stools and rooting system of the cane.

The larvae of two Noctuid moths, *Remigia repanda* and *Laphygma frugiperda*, feed on the leaf-blades of the cane, and at times occur in enormous numbers, stripping whole fields of their foliage, and leaving nothing but the hard midribs. These are destroyed by collecting the caterpillars in buckets containing paraffin and water. They become most numerous on the advent of rains after prolonged drought.

Two species of Termites occur frequently, and their characteristically constructed nests may be seen in parts of the fields. They destroy all canes which have been previously weakened by borer attacks, the tunnel of the borer often serving as an entrance. They will at times attack a healthy cane, though this seldom occurs. These

pests regularly receive attention, and the weeding gangs on all estates have orders to remove every nest which they meet with. These are collected in sacks, taken out of the field, and burnt.

A species of mealy bug occurs at times in large numbers beneath the sheathing base of the leaf. When large numbers are present they undoubtedly weaken the vitality of the cane. These insects are destroyed in damp weather by fungus. In dry weather they multiply rapidly and remain healthy.

Two species of Cercopidae, known throughout the West Indies as frog-hoppers, occur at times in small numbers, but their damage is generally speaking negligible. Owing to the clean weeding invariably indulged in, the numbers of these pests never become a menace to the industry as they have in Trinidad.

These notes cannot be terminated without some reference to the excellent control work carried on by most of the sugar estates through the instrumentality of their managers. Although the pests have by no means yet been controlled, combined efforts are being put forth to this end, involving considerable inconvenience and expense to each estate. Efforts such as these on the part of the practical man are exceedingly encouraging, and serve as an example to agriculturists in other parts of the world, who at times are inclined to consider economic entomology more in the light of an interesting hobby than a serious practice which will very handsomely repay the necessary initial expenditure.

COCONUTS.

Latterly the cultivation of the coconut palm has received considerable attention and large areas have been planted up in various parts of the colony.

Its chief insect enemy is the larvae of a butterfly known as *Brassolis sophorae*, L. This pest at times defoliates nearly every palm in a district.

The larvae are very distinctly gregarious and live in large nests which they construct themselves by drawing

together a number of leaves of the palm. Such a nest may contain close on a hundred larvæ.

These caterpillars feed exclusively at night. Their nests are conspicuous objects and it is an easy matter to send a boy up an infested palm and cut down the nests. Unfortunately it has been found necessary to enforce legislation so as to control this pest as many of the native cultivators refuse to regard the control thereof seriously.

An immense species of locust in one particular area has recently developed a taste for the foliage of the coconut palm and from time to time does a lot of damage.

Locust Invasion.

In 1917 we experienced an invasion of the South American imigratory locust from Venezuela.

After a strenuous fight of 5 months we were successful in eliminating the swarm and its progeny.

Legislation had to be carried out in some parts of the colony, however, and proved enormously effective especially against the gentleman who suddenly developed acute religious tendencies and declared that "as the Lord had sent these insects he would just as assuredly remove them again." The cost of this campaign was under £500 as against some £4,000 expended by the Government on a previous occasion before there was an Entomological Division attached to the Agricultural Department.

Minor Pests.

Other crops such as rice, citrus, coffee and cacao are not damaged to any extent by insect pests. This is particularly the case with rice. When the plant is in the nurseries, prior to be planting out, the larvæ of the Noctuid Moth *Remigia Repanda* often cause injury by feeding on the young green shoots. By flooding these nurseries the caterpillars can easily be got rid of. The small moth borer of sugar cane frequently attacks the grown plant.

Scale insects at times prove troublesome to citrus plants such as oranges and limes—especially limes. Cacao is more prone to fungoid diseases.

Time does not allow of an account of the pests which attack man and animals. A full description of such appeared in the publications of the Bureau of Entomology a few years ago. The ever increasing parts which such creatures are found to take in the destinies of human affairs point to their closer study in the future.

LANTERN SLIDES.

Twenty-five slides from the author's own negatives were shown at the conclusion of the paper. Seventeen of them pictured phases of insect control on sugar estates. The rest were incidents relative to the destruction of insect pests in the Colony.

Owing to pressure of space we have been obliged to hold over till the next number, the second and final instalment of the proceedings of this Conference.—Editor.

COLONY BIRDS IN RELATION TO AGRICULTURE.

No. 2—OLD WITCH.—(*Crotophaga Ani.*)

BY F. STELL, ASSISTANT GOVERNMENT BOTANIST AND MYCOLOGIST.

Of the several hundred species of birds found in the Colony, probably none are more familiar to the average person than the birds called locally—" old witches." They belong to the cuckoo group of birds, and the subject of the present note is by far the commonest species.

The old-witch is a comparatively large bird. Its length is about twelve inches and it is fairly plump. Some of its features are very prominent. The most pronounced characteristic is the keel-like crest on the upper part of the beak. This crest extends from the base to the tip of the bill.

The plumage is a deep black with violet-blue reflections A closer examination of the bird shows that the

feet are zygodactyle, *i.e.*, two toes are directed forwards and two backwards. The old witch has a weird distinctive appearance. Its habits, also, are peculiar. The outstanding feature is its social or gregarious mode of life. Along the road-sides, in the suburbs, and in various cultivations, one often encounters a dozen or twenty of these birds. They are very confiding. Whether this is absence of fear or the feeble power of flight possessed by the bird, it is difficult to say. Anyway, this species of cuckoo has a very clumsy, slow, and laboured flight, and only covers short distances. Unlike the European cuckoo, the "old-witch" does not derive its name from its call-note. The cry of the colony cuckoo is loud and harsh, a sort of scream, and not at all pleasing.

A unique quality of the gregarious habit is carried to an extreme point in the case of the " old witch ;" most birds live more or less socially at some stage of their life; it may be as nestlings, or in foraging parties, or in defending themselves against an enemy. Further, many birds adopt a colony habit for nesting purposes. But with the old-witch, the social habit of nesting is pushed to the extreme. One actually finds several birds making use of the same nest, and ten or a dozen eggs are quite frequently deposited in the same nest. This nest is an ugly, untidy structure, made of dry sticks and generally located in dense pimpler bushes. The freshly laid eggs have a coating of a powdery, calcareous nature; beneath this—which is readily removed—the colour of the eggs is a bright blue.

Like most organisms, the old-witch has to eat to live. What does it eat? Is its food such as to make it a friend or a foe of the agriculturalist? Does it do more good than harm, or *vice versa*? These are questions of practical importance and an accurate answer can only be declared from an analysis of stomach contents. However, caterpillars and insects generally are known to be consumed in large numbers by the cuckoo group of birds, though no doubt, some fruits are sampled and found satisfactory. The point to decide is: what is the balance of evidence; is it for or against the " old witch "? To this end, information from farmers and planters is solicited.

EXPORTS OF AGRICULTURAL AND FOREST PRODUCTS.

Below will be found a list of the Agricultural and Forest Products of the Colony exported during the first quarter of 1921. The corresponding figures for the two previous and the average for the four years previous to that are added for convenience of comparison.

Product.	*Average 1915-18.*	*1919.*	*1920.*	*1921.*
Sugar, tons ...	25,165	22,180	19,449	67,864
Rum, gallons	1,243,049	1,865,365	669,845	955,138
Molasses, gallons	1,900	164,113	None	None
Cattle-food, (Molascuit) tons	556	435	260	846
Cacao, cwts. ...	66	None	8	None
Citrate of Lime, cwts.	19	5	44	19
Lime Juice, gals.	1,105	None	None	No Records available
Essential Oil of Limes, gals.	8	5	None	
Coconuts, thousands	508	1,456	1,615	716
Copra, cwts. ...	607	762	None	330
Coffee, cwts. ...	891	5,751	989	299
Kola-nuts, cwts. ...	83	None	10	None
Rice, tons ...	4,589	638	5,519	None
Ricemeal, tons ...	70	None	None	None
Cattle, head ...	201	None	None	None
Hides, No. ...	791	2,291	2,265	839
Pigs, No. ...	226	None	None	None
Sheep, head ...	10	None	None	None
Balata, cwts. ...	2,614	2,004	1,786	3,139
Charcoal, bags ...	12,265	11,941	13,689	11,375
Firewood, Wallaba, etc., tons ...	2,743	231	1,063	1,732
Gums, lbs. ...	248	None	2,861	7,055
Lumber, cub. ft. ...	58,584	59,508	40,754	15,706
Railway sleepers, No.	3,627	1,308	3,310	2,614
Rubber, cwts. ...	240	42	100	726
Shingles, thousands	510	747	372	242
Timber, cub. ft. ...	28,445	8,137	14,689	41,567
Coconut Oil, gals....	6,557	11,941	13,689	6,209

ATTENDANCES AT THE DISTRICT GARDENS

Year.	Bourda.	Belfield, E. Coast.	Stanleytown, New Amsterdam.	Suddie, Essequibo.	Den Amstel.	Houston, E. Bank.	Wakenaam.	Total Attendances.
1912 ...	5,514	4,395	3,302	2,100	2,544	2,156	718	21,729
1913 ...	5,156	4,535	2,519	3,399	2,568	1,836	1,319	21,332
1914 ...	4,243	3,869	2,443	3,025	1,791	1,653	1,533	18,577
1915 ...	1,123	1,006	769	59	503	339	401	4,200
1916 ...	4,705	1,161	1,510	225	623	2,251	1,297	12,026
1917 ...	4,991	2,820	1,366	3,297	1,186	2,564	1,663	17,886
1918	4,834	3,081	1,653	2,671	2.162	2,790	2,067	19,258
1919	4,769	2,425	1,582	2,798	1,851	2,480	1,556	17,461
1920	6,285	2,312	1,665	2,525	2,532	3,228	2,148	20,695
1921								
1st Quarter	1,761	639	502	307	673	829	490	5,201

Meteorological Data—Jan. to March, 1921.

Months	Rain-fall.	NUMBER OF DAYS OF RAIN						Evaporation.	Air Temperature and Humidity.			
									Air Temp.			Humidity.
Botanic Gardens.	Total Inches.	Under ·10 Inches	·10 to ·50 Inches	·50 to 1.00 Inches.	1.00 to 2.00 Inches	Above 2.00 Inches	Total days	Inches	Maximum	Minimum	Mean	Mean
Jan. ...	4.81	9	7	2	1	...	19	4.35	83.7	74.9	79.3	78.6
Feb. ...	.48	...	3	...	...	...	03	5.30	84.6	74.7	79.6	73.1
March ...	3.45	5	10	1	...	...	16	5.71	85.0	75.0	80.0	78.5
Totals & Means.	8.74	14	20	3	1	...	38	15.36	84.4	74.8	79.6	76.7
Berbice Gardens												
Jan. ...	5.20	3	8	2	1	...	14	...	91.8	75.2	83.5	77.9
Feb. ...	1.92	2	3	...	1	...	6	...	89.3	75.0	82.1	71.5
March ...	1.45	2	4	1	...	...	7	...	87.0	74.9	80.9	74.6
Totals & Means.	8.57	7	15	3	2	...	27	...	89.3	75.0	82 2	74.6
Onder-neeming.												
Jan. ...	4.72	...	8	3	1	...	12	...	87.6	72.8	80.2	...
Feb. ..	.30	1	2	...	...	...	3	...	87.0	72.7	79.8	...
March ...	2.41	5	9	1	...	...	15	...	87.6	72.5	80.0	...
Totals & Means.	7.43	6	19	4	1	...	30	...	87.4	72.6	80.0	...
Mora-whanna												
Jan. ...	10.06	7	8	4	2	1	22	...	...	...	...	...
Feb. ...	6.43	3	7	2	...	1	13	...	...	...	...	...
March ...	6.59	3	15	3	...	...	21	...	...	...	...	...
Totals ...	23.08	13	30	9	2	2	56	...	...	...	...	...

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TIMBER.

Reconstruction at home and a development of tropical resources abroad are to-day proceeding as a natural aftermath of the war.

Timber must necessarily play a large part in reconstruction of all kinds and as the more accessible sources of this all important commodity gradually fail to meet the ever increasing European demands, other and more distant areas will naturally be sought after.

The practical article in this number which comprises all of what is to-day known of British Guiana timbers—their accessibility, varieties and values, indicates that we are in a position to meet a vast demand for timber for a wide variety of purposes.

What development of this great source of wealth of ours has taken place?

Very occasionally an ocean going steamer or sailing barque penetrates up the Demerara or Essequebo River and removes a few thousand feet of greenheart and the local Carpenters find it cheaper to construct dwellings of imported pitch pine! Much firewood, shingles

and charcoal is shipped annually to Barbados and other West Indian Islands; in return are imported sweet potatoes and occasionally fruit, both of which might well be produced locally.

As Mr. Hohenkerk's contribution briefly indicates, a deal of knowledge remains to be acquired concerning our timbers and, further, their values must be made more widely known to the world in general before we can commence to look forward to a timber industry of any established magnitude.

AN ANNOUNCEMENT.

The following telegram was received from the Secretary of State for the Colonies by His Excellency the Governor, date June 2nd 1921 :—" It gives me much pleasure to inform you that His Majesty has been graciously pleased to approve of Knight Bachelor for Professor Harrison."

Thus the many achievements and distinctions won by Professor Harrison in the course of a long and arduous career wholly given to the interests of science and agriculture in the West Indies and British Guiana have been well and fittingly recognized.

We feel both glad and proud of being able to take this opportunity, in a publication of which he was the founder some fourteen years ago, of offering our very sincere congratulations to Sir John and Lady Harrison.

FORESTRY IN BRITISH GUIANA.

An extract from the Statement prepared for the British Empire Forestry Conference by the Forestry Officer of B. Guiana.

AREA COVERED BY EXISTING FORESTS.

The forests of British Guiana are estimated to cover 78,680 square miles, or 87·9 per cent. of the total of 89,480 square miles. The easily accessible area of the Colony, is that portion lying between the coast and the rapids in the rivers, totals 18,500 square miles made up of the following areas: Forest land, 13,000 square miles; non-forested lands:—In cultivation 900, Muri or scrub 1,400, wet savannahs 1.200, and dry savannahs 2,000, making a total of 5,500 square miles.

The remaining area of the Colony from the rapids inland (with the exception of the Essequibo river lands above Rockstone Railway Terminus, which is being worked for Greenheart timber) totalling 70,980 square miles, is made up of forests— 64,780, and dry savannah (or grass) areas—6,200 square miles.

The lands alienated from the Crown equals 1,800 square miles, being 2 per cent. of the whole area or 10 per cent, of the accessible area of the Colony. Land under temporary cultivation by the aborigines, which, after producing one, or at most two crops, are allowed to again become afforested, are not included in these figures, but their aggregate area would not exceed 150 square miles.

Indian Reservations are those areas reserved from the Crown forests by the local Government for the use and benefit of aboriginal tribes, from which only limited quantities of timber and balata are produced by the Indians. All of these Reservations are situated in the easily accessible area: their total area of 1,360 square miles is included in the area of Crown Forests, viz., 12,100 square miles.

Table 1.—STATEMENT showing the Total Area of Forest and the Percentage of the Land Area covered by Forest.

—	Agricultural Land.	Forest. Merchantable. (Estimated.	Forest. Unprofitable or Inaccessible.	Forest. Total.	Other Land. (Estimated.)	Total.
Sq. miles ...	900	13,000	64,730	78,680	*Accessible*— Muri or scrub 1,400 Wet Savannahs 1,200 Dry Savannahs 2,000 *Hinterland*— Dry Savannahs 6,200 10,800	89,480
Percentage of total area.	1	14.5	72·4	87·9	12·1	

OWNERSHIP OF FORESTS.

The Crown controls the whole of the forests of British Guiana with the exception of those on alienated or privately owned lands. These private lands are estimated to aggregate 1,800 sq. miles, of which about one-half is in forest and the other under cultivation.

Licences, renewable annually and a few issued for two or five years, are granted by the Crown for wood cutting; 402 of these, aggregating 575 sq. miles, are in existence, and this area is included in the area of Crown Forests.

FORESTRY ACTIVITIES OF COMPANIES AND PRIVATE INDIVIDUALS.

There are in existence 402 licences for cutting wood over the Crown Forests, aggregating in area 575 square miles, or about 3 per cent. of the easily accessible area of the Colony. These licences are issued for terms of one to five years, the majority being for the shorter period renewable annually. The titles are held by eight incorporated limited companies, four other companies, and by 138 individuals. Of this total number 36 tracts are for selective cutting of Greenheart only. The remaining tracts are for cutting small timber and fuel wood, and for producing shingles, staves and charcoal.

Some of the timber cutters, both companies and individuals, possess power mills for sawing logs, scantlings, and boards; 12 mills are situated in the country districts or up rivers, 3 in New Amsterdam, the chief town, and 7 in Georgetown, the capital, making a total of 22. Some of those in New Amsterdam and Georgetown have wood-working machines also in operation. The local Government own one saw-mill 65 miles up the Demerara river, worked by water-power, the timber for which is purchased at market price from natives or Indians.

Greenheart timber is hewn, alongside the stumps, into square logs, which are hauled and transported to the nearest shipping point. The haulage hitherto has been done by man power or oxen, and only in the last year or two has motor-tractor haulage been adopted by some of the larger operators. The logs, being heavier than water, are slung on each side of long, narrow, flat-bottomed punts, each carrying from two to six logs, and poled down the smaller streams to the rivers, where they are transferred to larger punts, which transport loads of 2,000 cubic feet or more to the loading ocean vessel or to the mills.

Shingles, staves, posts, fuel wood and charcoal are hauled in carts by mules or donkeys to the shipping points on streams navigable for large punts or lighters.

Annual Increment and Utilisation of Home-Grown Timber.

A.—*Increment.*

Unfortunately in this Colony forestry investigations and tree measurements have not progressed to the stage where estimates can be made of stands of timber, and this, coupled with the lack of accurate, or even approximate, topographical surveys, precludes the forming of

even rough estimates of the increment per square mile, or of losses through fire, waste, or decay, in Crown or privately-owned forests.

It is known that at periods of drought which occur about every ten years forest fires are numerous, and at certain times and places very destructive, so much so that instead of a stand of all kinds, from 18 inches girth upwards of about 140 to 160 trees per acre, there have been found in places only from 15 to 20. But the extremely rapid growth of tropical vegetation causes these places to be naturally reafforested with quick-growing soft wood trees in comparatively few years.

B.—*Utilisation.*

No records are available showing the amount of timber or forest products obtained from privately owned lands; Table IV therefore gives the quantities and values only from the Forests under State control, including timber, &c., cut by Aboriginal Indians.

During the previous five years 1909-1910 to 1913-1914, Greenheart timber obtained was 527,355 cubic feet, and British Guiana Mahogany 59,993 cubic feet, showing by comparison with the last five years, respectively, an increase and a decrease in the production of these two woods.

Local prices have risen considerably from pre-war years up to the present time, and there is no likelihood of any great drop in the near future. The table shows that the estimated value of timber produced averaged 313,065 dollars or £65,222, and including Forest products, the total production from the Crown Forests averaged 1,179,380 dollars or £245,704.

Table IV.—Annual Utilisation.

—	Type of Product.		Quantity.	Estimated value at place of preparation $.
A.—*Timber*— Under State control	Greenheart and mora, cut by Indians, average for 4 years, 1915-1919	cubic feet	6,338	1,315
	Greenheart average 5 years, 1915-1919	,, ,,	558,982	288,820
	Other hard woods, four years, 1916-1919	,, ,,	73,664	11,800
	B.G. mahogany, average 5 years, 1915-1919	,, ,,	53,030	6,900
	All other timber, average 4 years, 1916-1919	,, ,,	34,205	4,230
Other	Mora, other hard woods and soft woods	,, ,,	Unknown	Unknown
Total	... ...	...	...	$313,065 (£65 222
B.—*Forest Products*— Under State control	Vat and fencing staves, posts, &c., from Indians, average 4 years, 1916-1919	number	...	1,315
	Wallaba shingles, average 4 years, 1916-1919	,,	5,686,145	24,500
	Wallaba staves, ,, ,, ,,	,,	202,468	25,000
	Wallaba and other posts, average 4 years, 1916-1919	feet	350,752	5,500
	Wattles and sticks, average 4 years, 1916-1919	number	14,876	450
	Fuel wood, ,, ,,	tons	78,560	232,500
	Charcoal, ,, ,,	,,	4,556½	70,000
	Tanning bark, ,, ,,	lb.	83,335	400
	Balata, ,, ,,	,,	1.407.272	506,620
	Gum, ,, ,,	,,	327	30
Other	Shingles, staves, posts, wattles, fuel wood and charcoal		Unknown	Unknown
Total	... ...	...	...	$866,315 (£180,482)
Grand total value of timber and forest products from Crown forests			...	$1,179.380 (£245,704)

Forest Industries, Statistics of Volume of Timber, &c. Consumed, and of Value of Product and Number of Persons Employed in Main Forest Industries.

The timber cutters, charcoal burners, and other men working on a licensed woodcutting grant, and also the foreman and bleeders on a tract licensed for balata production have, by law, to be registered.

Table V gives the consumption of timber and wood products, and the men registered during the past five years for such work. In the previous four pre-war years the numbers of men registered for work on timber and balata grants were, respectively, 1,389 and 3,764.

Table V.—Forest Industries.

Industry.	Estimated Volume of Timber consumed.		Estimated value of Product at Place of Preparation.	Number of Persons employed.
			Dollars.	
Timber ...	Greenheart ... cubic feet	460,400	237,888	Average for five years, 1915–1919 registered men 2,977
	All other timber ,,	23,070	3,290	
Principal wood products	Shingles ... No.	2,765,283	11,915	
	Fuel wood ... tons	70,615	208,986	
	Charcoal ... ,,	2,026	31,125	
	Also staves, posts and other articles.			
Balata	Nil (all exported)		...	3,594

Summary and Outlook.

A.—*The Total Home Consumption of Home-Grown and Imported Timber.*

The figures given below in Table VII are averaged for the last five years and, as already stated, represent timber only from Crown forests.

The average amounts of the principal wood products for the last four years are as follows :—

Type of Product.		Utilization.	Exports.	Home Consumption of Home-grown Product.
Shingles ...	No.	5,686,145	2,920,862	2,765,283
Fuel wood ...	Tons	78,560	7,945	70,615
Charcoal ...	"	4,556	2,530	2,026

The factor which appears to operate against the larger use of local wood is that the imported lumber has been more or less seasoned, and is fit for use at the time of purchase, whereas there is no artificial or other seasoning of local timber before it is milled. In consequence of this the imported lumber amounts to over 200 per cent. of the home-grown lumber used.

TABLE VII.

Type of Product.	Utilisation.	Exports.	Home Consumption of Home-grown Timber.	Imports.	Total Home Consumption of Home and Imported Timber.	Net Increment.	Balance
Timber ...	Average 5 years Cub. feet	Average 5 years Cub. feet	Cub. feet	Cub. feet			
Greenheart ...	560,000	99,600	460,400	Pine lumber,			
All other timber ...	166,220	23,070	143,150	337,720			
Total ...	726,220	122,670	603,550	337,720	941 270	Unknown.	Unknown.

B.—*Probable Duration of supplies at Normal Rates of Cutting and of Growth.*

Unknown.

C.—*Short Summary of Steps which should be taken to Protect and Develop the Forest Resources of the Country.*

For the proper protection of the forests of this Colony a greatly enlarged knowledge of the habits of growth and rate of annual increment of the various species is required. It would be necessary to inspect carefully and in detail forests now being cut and already cut over both recently and many years ago, together with the adjacent virgin forests, in order to comprehend the process of natural re-afforestation in the tropics, the percentage of different species during the various stages of this second growth, and to obtain some idea of the rate of such growth.

In Greenheart forests the cutting of timber is purely selective, and frequent inspections during the working of the tracts are necessary to compel the utilisation of marketable timber, *e.g.*, upper parts of stems and the branches, and thus prevent the present lamentable waste. Should clear-felling be adopted it will be necessary to compel cutters to leave a proportion of parent trees of the more valuable species on every acre cleared, and it will also be necessary to control cutting in order to prevent the clearing of excessively large areas with the consequent interference of climatic conditions.

Investigation of burnt areas in easily accessible districts should be made during the progress of the fire or shortly after, in order, if possible, to determine the origin and area of destruction. The natives and forest workers should be warned both by written and spoken word of the careless use of fires in the forest during the dry seasons; and the present practice of burning off grass areas or fields cleared for cultivation should be prohibited except under the control of a forest officer or ranger.

This would require material enlargement of the Forestry Staff, which now consists of only one officer, seven rangers, and one native assistant for botanical and other work.

To develop the forest resources roads or railways are required, traversing the easily accessible districts and extending into the mountainous country beyond; clear-felling down to marketable sizes of all species should be adopted; modern methods of haulage and transport are required; saw-mills of modern type should be erected on navigable rivers, as near the site of cutting operations as possible, each of which should have a kiln for artificially seasoning timber; wood-working machinery for making tool handles and other articles; a chemical and physical laboratory for testing latices, gums and saps for dyes, medicinal and other properties, and to ascertain the suitability of woods for manufacturing paper pulp, wood alcohol, acetone, &c., advertising the timber possibilities of the country in order to reach prospective investors.

THE IMPERIAL ENTOMOLOGICAL CONFERENCE—(*Contd.*)

Thursday, June 3rd.

In the Chair—Professor E. B. POULTON, F.R.S.

Discussion: "The Education of Economic Entomologists."

Professor H. Maxwell Lefroy read a highly interesting paper on "The Education of Economic Entomologists." Prof. Lefroy's paper bore considerable weight as he has wide experience in such work.

Dr. R. J. Tillyard (Australia) agreed with many of the points made by Prof. Lefroy and emphasized the necessity of a University Natural Science Course as the basis for an Economic Entomologist's training.

Dr. L. O. Howard (U.S.) gave short details of the kind of training that economic entomologists received in the States. He agreed that training in agriculture was also necessary.

Dr. R. Stewart MacDougall (Edinburgh) remarked that the study of Botany was also necessary. Every student at Edinburgh had a chance of becoming an economic entomologist.

Mr. H. A. Ballou (Barbados) also emphasized the necessity of a broad training in agriculture as part of the equipment of a competent entomologist. Other subjects such as plant physiology and mycology were necessary if the entomologist was at all likely to have to work alone.

After a number of other Delegates had spoken the Chairman, in an able summing up of the discussion, remarked that it was the man and not the system that counts.

The meeting was brought to a close by a Resolution which was carried with considerable enthusiasm, to the effect that "This Conference expresses to the United States Government, through Dr. Howard, thanks for the generous way in which they had distributed their valuable publications.

Afternoon.

A staff Conversazione was held at the Natural History Museum, South Kensington.

Some interesting exhibits were on view illustrative of some of the phases of work performed by the staff of the museum during the war,

An enjoyable afternoon was spent; the proceedings terminated with an official photograph of the delegates.

Friday, June 4th.

Visit to Rothamsted—This famous experimental station, which was founded as far back as 1843, proved of very considerable interest. The various experimental plots were ably demonstrated including those on the well known Broadbalk field. Later in the day an interesting discussion was held on "Tropisms and their Interpretation" which was opened by Dr. A. D. Imms of the Entomological Department of the Station. The various investigations in the laboratories were demonstrated and proved of absorbing interest.

The writer, who had previously visited Rothamsted in 1909 and 1910, whilst an agricultural student at Cambridge University, was particularly interested in the great developments that have taken place.

Monday, June 7th.

In the Chair: Sir Daniel Morris, K.C.M.G.

Discussion: "Resistance of Plants to Insect Attacks."

Mr. H. A. Ballou (Barbados) in an interesting paper opened the discussion. The substance of his remarks was that it is not merely the case that unhealthy plants encourage insect attack but that healthy plants appear frequently to possess some quality that operated as an actual deterrent.

Mr. F. A. Stockdale (Ceylon) gave a number of instances of insect attack on both healthy and unhealthy plants. He concluded by drawing attention to the necessity for carefully dealing with agricultural conditions in combating insect pests.

Dr. R. J. Tillyard (New Zealand) referred to the resistance of apple to wooly Aphis.

Mr. C. F. C. Beeson (India) stated that in India, forest borer epidemics always followed some primary cause such as forest fires, bad soil aeration, etc. He thought that ultimately insect control will be effected by agricultural methods.

Mr. F. W. Urich (Trinidad) said that in Trinidad thrips attack all cacao trees whether in good or bad condition.

Prof. H. M. Lefroy pointed out that there was a distinction in immunity from biting and from sucking insects.

Mr. C. P. Lounsbury (South Africa) stated that many of the South African scale-insects thrive best on the best cultivated trees.

Mr. H. A. Ballou in closing the discussion remarked that there was a good deal of recognition of his contention in all the remarks made. He was certain that agricultural methods influenced infestation.

Afternoon.

Mr. G. E. Bodkin (British Guiana) read his paper on the insect pests of that Colony. The paper was illustrated with numerous lantern slides.

Mr. F. W. Urich (Trinidad) followed with a paper on the Insect Pests of Trinidad.

Mr. H. A. Ballou (Barbados) then read a paper entitled "Review of the conditions in the West Indies in regard to agriculture and crop pests."

Tuesday, June 8th.

Visit to Oxford—An interesting time was spent here principally in the Hope Museum with Professor E. B. Poulton, F.R.S. The magnificent collections were inspected also those formed by Prof. Poulton illustrative of the many phases of mimicry. The writer was much interested in several large collections of British Guiana butterflies.

Interest was also aroused in the immense larva of a West African Lasiocampid moth which dwarfed any such form even in this country of entomological wonders: many of the scientific laboratories, some of comparatively recent origin, were viewed.

The day terminated with a tour of the various colleges.

Wednesday, June 9th.

In the Chair: Professor R. Newstead, F.R.S.

Discussion: "Artificial *versus* Natural Methods of Control of Insect Pests."

Dr. F. W. Urich (Trinidad) stated the case by illustrations from the frog-hopper problem in Trinidad. He detailed the various artificial methods that had been attempted. Dusting with the green muscardive fungus had given satisfactory results. In conclusion he remarked that much good resulted from agricultural methods such as forking, weeding and draining.

Mr. R. J. Tillyard (New Zealand) gave instances of natural *versus* artificial control in New Zealand.

Mr. Balfour Browne (Queensland) did not agree with the importation of natural enemies into a country to control a pest therein. Such importations had been known to do more harm than good. He cited instances thereof.

Mr. H. H. King (Sudan) believed that most agricultural pests could be controlled by cultural methods. This entailed a knowledge of the correct method and co-operation between the growers.

After a number of the delegates had spoken the Chairman summed up by stating that the introduction of natural enemies was advisable, care, however, should be used in their selection so that crops should not be endangered.

Afternoon.

Dr. R. Stewart MacDougall read his paper "Insects in relation to afforestation" illustrated by slides.

Mr. F. A. Stockdale (Ceylon) read his paper on "Insect Pests of Tea in Ceylon."

Thursday, June 10th.

Visit to Cambridge—A valuable time was spent with Prof. Nuttall, F.R.S., Quick Professor of Biology in the University of Cambridge. The entomological work carried on in the school of Agriculture was inspected, also the collections in the Cambridge University Museum.

The Conference terminated with a dinner at Lancaster House on Friday, June 11th.

A toast "The Delegates to the Imperial Entomological Conference" was made by the Right Honourable the Viscount Milner G.C.B., G.C.M.G.

Prof. R. D. Watt (Australia) responded.

Imperial Entomological Conference.

The following resolutions were unanimously adopted by the Conference on the 11th of June:—

(1) In the opinion of this Conference it is most desirable that similar Conferences should be held in London once in five years.

(2) This Conference would view with dismay the possibility that the Imperial Bureau of Entomology should, through lack of funds, cease or in any way curtail its present work, and recommends most strongly that steps be taken to establish the Bureau on a permanent basis.

(3) In order to place the Bureau on a sound financial basis, this Conference recommends that all the contributing Governments should be urged to guarantee their contributions, subject to the proviso that any Government be at liberty to raise through its representative at quinquennial Conferences the question of modifying the amount.

(4) This Conference recognising that the funds now contributed for the upkeep of the Bureau are quite inadequate, recommends that the annual contributions should be increased so as to provide a total income of not less than £13,000 per annum in order to allow for the necessary staff to carry on work on existing lines.

(5) This Conference accepts the recommendation of the Special Committee that the Secretary of State for the Colonies be requested to establish a Provident Fund for the staff of the Bureau in lieu of pension rights.

(6) This Conference agrees that full power should be left to the Director and Managing Committee of the Bureau to exercise their discretion as to the General scope and contents of the Publications of the Bureau and the expenditure involved thereby.

(7) This Conference agrees that the appointment of a Coccidologist to the Staff of the Bureau is unnecessary but considers that the Director should encourage members of his staff to pay special attention to particular groups, especially to those for the identification of which no specialist is available.

(8) This Conference considers that the provision of an adequate number of trained men to carry into effect existing plant import legislation is of more immediate importance than the revision or extension of such legislation.

(9) This Conference accepts the report of the Sub-Committee on the Convention prepared at the International Conference on Phytopathology held at Rome in March, 1914.

(10) The Delegates to this Conference desire to express their sincere thanks to the Chairman, Viscount Harcourt, the Honorary Committee of Management, the Director and the Assistant Director of the Imperial Bureau, for the excellent programme drawn up and carried out by them, and also to Professor Poulton and Dr. Dixey, of Oxford University, Sir Arthur Shipley and Dr. Hugh Scott, of Cambridge University, Dr. Russell and Dr. Imms of the Rothamsted Experimental Station, for the enjoyable and instructive visits arranged by them.

REMARKS ON OUR MILK SUPPLY.

By Mr. G. Grant.

We have reproduced this paper from the Proceedings of the Agricultural Society of Trinidad and Tobago as it contains a number of points of interest to our local dairymen.—Editor.

I have classified them under the following headings:

1.—Breeding.
2.—Feeding.
3.—Diseases.
4.—Milking Methods.
5.—Education.
6.—Goat Raising.

BREEDING.—This is where the greatest fault lies. Very seldom is any selection done, the cow being sent to the nearest bull. Good bulls of milking strain are few and far between in Trinidad, but this is a matter which can be remedied either by Government help or through Community Breeding.

As far as breeds are concerned it would seem proved that pure breds from Northern climates do not thrive with us. The Zebu has proved that it can stand our climate well, and is a decided improvement on the local stock. A type that seems to give best results is either the pure bred *Zebu of a milking strain* or a cross between the Zebu and good Dual Purpose Northern stock, such as the Red Poll. The water Buffalo often called "Hog Cattle" also claim attention and are strongly advocated by some as the animal for the country to adopt. Most authorities agree that the Zebu with its high resistance to sun, ticks, and Strongylus should form the greatest factor in improving our stock, either by crossing with our native animals or preferably with high producing Northern cattle.

FEEDING.—This is a point that too few pay attention to. An animal needs a certain amount of food to keep itself thriving, and the rest of the food it digests goes either to form fat or milk, depending on the cow. Concentrates or food rich in protein chiefly; not only keep the cow in better condition and lead to better yields, but often tend to lengthen the milking period. Numerous experiments have been carried out to determine whether the quality of the food has any influence on the percentage of fat in the milk but they all show that where there is any influence it is only for a few days at the most, and that after that time the milk goes back to normal. In exceptional instances there has been a slight difference, but this seems to be due to the very sudden change in the ration of the animal, and when we consider the nervous disposition of the cow we can readily see how this came about. Oilmeal and other concentrates can in the writer's opinion, be used more than at present with paying results.

DISEASES AND PESTS.—The chief disease is Strongylus, caused by an intestinal parasite very similar to that causing hook-worm in man, Some authorities claim that it is present in 90% of our stock. Very few of the smaller cattle owners seem to know of its existence or of the harm it does to their stock, and certainly very few know what to do to keep it in check. It seems to be

a case where a programme of education is advisable, or rather, distinctly necessary. The following methods of control have given good results ;—

1.—Pasturing animals after the dew is off the grass. It has been found that the parasite stays at the tips of the blades of grass as long as there is dew on them, but when these dry it goes down to the roots and into the ground to get at the moisture there.

2.—Spraying pastures first with salt and after with lime. Soot is used in some countries but is not obtainable here to any extent.

3. The use of some of the best Worm and Condition Powders on the market. Turpentine is also recommended.

4.—Fumigation with sulphur, This should be used only as a last resort as it sometimes proves fatal.

TICKS.—The presence of ticks is making itself more and more felt, and this is only natural as no concerted effort has as yet been made to keep the tick from spreading. Ticks not only cause loss of blood, damage to hides, general debility, etc., but in some cases are the spreaders of some of our worst stock diseases.

Experiments conducted by the U S. Dept. of Agriculture have shown that the yield of milk is appreciably reduced when ticks are allowed on cattle. The remedy is simple. Spraying with some effective dip should be made compulsory.

MILKING METHODS.—The usual method is to allow the calf to suck both before and after milking. This lowers the percentage of fat in the milk, usually caused digestive troubles in the calf, due to the excess of fat in the "strippings" or last drawn milk which the calf receives, and often is the cause of the short milking periods so common in our cows. Wherever possible more similiarity in length between periods of milking would be better.

EDUCATION.—I consider this to be essential if we are to expect any considerable improvement in our milk supply. The greater percentage of cattle raisers here are more or less uneducated and it will be hard to get them to change any of their ideas, but they are the ones through whom we can make the most improvement in our milk supply. This may be done through the different agricultural societies, especially if the members would interest themselves in the matter. Especially is education necessary as regards Breeding, Treatment of the common diseases, and Milking Methods.

GOAT RAISING.—The keeping of goats would be a great help in increasing the milk supply of the island. Many more people could keep them than are now doing so. Goats are easily reared give better returns for feed than do cattle and the milk is free from tuberculosis, again the milking qualities in goats can be more quickly raised than with cows. As with cows, pure-breds do not thrive so well as half-breds, and the best results will be got by crossing Toggenburg or Sinaan rams on natives ewes. Service stations could be established in different parts of the island, e.g. The St. Clair Experimental Station, Government Farm, etc.

Notes on Government Standard.

We have evidence showing that tropical animals give at least as high a percentage of fat as do those in more temperate regions. I do not think therefore that the present standard of 3 % fat should be lowered when we consider that it is already relatively low. e.g. the standard in Canada and in most of the States is 3.5 per cent.

Poor milk may be said to be due to three reasons:

1.—Watering or Skimming—Either of these merit severe punishment.

2.—Improper methods of milking—By allowing the calf to suckle it gets the richest portion of the milk, what is left for sale being of an inferior quality. Proper education would remedy this difficulty.

3.—Poor Cattle.—Very few cattle should give milk testing below 3 per cent. fat. These should be got rid of, or the milk kept solely for home use or stock feed. The per cent. of fat can readily be increased in the progeny of such an animal if it is bred to a bull of a high fat-content strain.

To avoid all suspicion on the part of the milk vendor I would suggest that it be made compulsory for a constable to take three samples of any suspected milk; one of these to be left with the vendor, one with some responsible person, and the other to be kept by the constable himself. All must be properly sealed and kept so as to settle any dispute that may arise later on.

SOME INTERESTING PLANTS.

By J. F. Waby.

Adansonia digitata, "Baobab," "Ethiopian Gourd," "Pain de Singe," "Monkey Bread," "Gorakimli," "Gourrik Chinty," "Salo," from Northern Africa, Ethiopia, supposed to be the largest tree in the world. It is a most peculiar tree in some respects not unlike the mighty "Ceiba" or large "Silk Cotton tree" of the West Indies, particularly as it is seen growing in Barbados; there it forms immensely tall trees with gouty stem, tapering gradually in its full height. In the Botanic Gardens, British Guiana, there are no large trees of this species, what few plants there are they are comparatively young as the Gardens did not exist before 1879. These plants have not yet produced flowers, but they follow the general form of the tree,—an exceedingly gouty stem with stout brittle branches. The one large conspicuous tree in Trinidad, in the entourage of the Queen's Park, almost opposite the Princes Building, is a typical specimen, though rather short, measuring at the ground-line 9 ft. in diameter, and 5 ft. 6 in. at 6 ft. above, tapering rapidly

upwards; the branches are stout and rigid, covering a space of 25 ft. on either siae. It is deciduous. The foliage is compound, palmate, digitate, of 5 or 6—generally 6 leaflets, almost sassile, radiating from the top of the petiole which is 4—5 inches long, stout, leaflets entire, oblong, 3—4 inches long, 17/8—2 inches wide, dark green above, pale beneath. Midrib pronounced, veins regular close together. The foliage is borne in terminal crowns of 7 or 8 leaves. The infloresconse terminal, solitary, by the side of the crown of foliage, pendant on a stout green peduncle 16—17 inches long, varying in thickness from $\frac{1}{4}$ inch at top to $\frac{1}{2}$ inch at base. The unopened flower is a conspicuous, slightly ribbed, pointed green cone at the end of the peduncle, $2\frac{1}{2}$—3 inches diameter, which breaks open at the point into 5 segments, this the calyx at least $\frac{1}{8}$ inch thick, which folds backwards to within an inch of the centre. The corolla is formed of fine thick waxen white petals overlapping each other and curving backwards and crimping 3 inches long and wide, these with age turn rusty brown. A white column occurs below the corolla $1\frac{1}{4}$ inches long, and $\frac{3}{4}$ inch thick, at the base of which is a ball of innumerable white filaments with small brown anthers, $2\frac{1}{2}$ inches in diameter. The female organ springs from the base to the ball of filaments; a hollow white funnel-like tube turned upwards 3 inches long, $\frac{1}{8}$—$\frac{3}{16}$ inch thick, the end opening flattened, bifid, $\frac{3}{8}$ inch across each half with several incisions $\frac{1}{8}$ inch deep, brown. The inflorescense is in every respect peculiar in its formation and always attracts attention as there is scarcely another similar. There was but one fruit produced and this disappeared without my knowledge.

Aniba megacarpa, "Laurier matac," a timber tree of Trinidad, 60 feet or more high. The branches are strong and in lateral spread in tiers. The foliage is in small groups on small branches in tiers, the latter slate-coloured The leaves 6—7 inches long, (petiole short) 2—$2\frac{1}{2}$ inches wide, stiff, coriaceous, dark green above, pale yellowish; beneath, entire midrib plain, yellowish veins regular, obliquely across. The infloresscense terminal in axils, paniculate flowers very small unisexual. It bears a dark

brown coarse woody cupula, urn-shaped, 2 inches diameter and high, with coarse crenations on the top; a cavity $1\frac{1}{8}$ inches across the top and $1\frac{1}{8}$ inches deep, in which is fitted a spherical fruit, $3\frac{1}{4}$ inches long, one inch diameter, bluntly pointed, smooth, slightly furrowed, purplish black. The fruit drops out as soon as ripe and the cupula soon falls afterwards. The skin of the fruit peels off dry, leaving a spherical, polished brown hard shell nut, 2 inches long, and $\frac{3}{4}$ inch in the middle. It is not known if the nuts are edible.

Omphalea magacarpa, "Huntsman's nut" of Trinidad. A strong climber, reaching up into the largest trees enveloping the principal branches. The foliage fairly heavy in groups, and apparently deciduous, leaves alternate, oblong, pointed, cordate at base, entire, 8 inches long, $3\frac{1}{2}$ inches wide, glabrous, dark green above, pale beneath, smooth, edges slightly curved backwards; midrib and main veins prominent beneath, the latter widely distant, cross veins thin anastamosing closely between. Petioles 2—3 inches long, fairly thick. inflorescense terminal, paniculate, unisexual; flowers very small in the axils, a linear bract an inch long at each axil. The fruit globular pointed, 3 inches diameter, with 3 slightly raised ridges ending in a short nipple. It turns yellow on ripening with a rather soft thick skin and falls to the ground, bursting on impact, by the ridges into 3 equal portions of a very thick mealy substance tightly enveloping 6 large brownish nuts, closely and shortly muricate, rounded triangular, flat on the inner side, round at the back, $1\frac{1}{2}$ inches wide, $1\frac{3}{4}$ inches long, $\frac{7}{8}$ inch thick; the shell of the nut quite hard $\frac{1}{16}$ inch thick, white lined, with a clear-white kernel $1\frac{1}{8}$ inches diameter, $\frac{3}{4}$ inch thick, which is said to be intensely purgative.

Warzewiezia coccinea, "Chaconier" of Trinidad. A tall-growing, slender woody branching tree on the hill-sides and in the valleys, looking like a strong-growing climber. A beautiful sight of yellow and scarlet, the latter predominating. The foliage in pairs, large, oblong-spathulate entire, 12 inches or more long, 4—5 inches wide, dark green; midrib conspicuously pale green, veins regular and straight across, $\frac{5}{16}$—$\frac{1}{2}$ inch apart, prominent

below; petiole 1 inch long, inflorescense terminal, 12—18 inches long; flowers small, yellow, in short fascicles in pairs, $\frac{3}{4}$—1 inch apart, one or two scarlet bracts to each fascicle, the petiole of these slender, an inch long, the blade oblong, 2—2$\frac{1}{2}$ inches long, 1—1$\frac{3}{4}$ inches wide, pointed, several straight veins running from the base; the bracts lying over on each side making the inflorescense very conspicuous. The fruit a mass of small green knobs at each fascicle.

Napoleona imperialis, "Napoleon's star" of Sierra Leone. A rather scrambling hard-wooded large shrub. The foliage dark green, entire, oblong, pointed, 5-7 inches long, 2-2$\frac{1}{2}$ inches wide. Flowers solitary, sessile, generally on the naked branch, sometimes amongst the end leaves. A peculiarly beautiful object with a rather fœtid odour. The base of the flower is like a 5 pointed star 1$\frac{3}{4}$ inches across, fixed to the centre and edging it all round $\frac{5}{8}$ inches wide, of a peculiar dark chocolate colour, edged with deep orange, fluted and toothed all round. Above this is a fringe of white filaments $\frac{3}{16}$ inch long. The centre of the flower is like a button $\frac{5}{8}$ inch across, curved inwards in close sections,—these are the stamens arching to the pistil in the centre, which is a dark red mass. Outside this button of stamens is a crêpe-like frill nearly $\frac{1}{4}$ inch wide, cream coloured, deeply knotched, the points a dark red, with a bright red circle underneath close to the fringe of filaments. Below this is a green calyx of 5 sepals an inch across. No fruit has been seen.

Adhatoda cydoniaefolia, a large spreading handsome shrub from Brazil, 5-6 feet or more high, and spreading as much, very floriferous, wood brittle, square jointed 3-4 inches apart. The foliage 12-14 inches long, 5-6$\frac{1}{2}$ wide, entire, oblong, pointed, of an ordinary green, veins regular and plainly marked. The inflorescense a terminal pyramidal panicle 15 inches long, bracts in pairs or double pairs on alternate sides 6 inches long; the beauty of the inflorescense is that of the bracts which are of a bright purple colour, set 3 together 1 large and 2 small, the large

2 inches long by $1\frac{1}{4}$ inches wide, the small ones 1 inch long by $\frac{1}{2}$ inch wide; the flowers, white tinged with pink, spring from between the bracts, $2\frac{1}{2}$ inches long, the tube $1\frac{1}{2}$ inches, narrow; the 2 stamens and pistil nestling in the hollow, with a curved portion in front as long as the tube but rather wider. The calyx 5 pointed $\frac{5}{8}$ inch long, pinkish. The fruit a thickish spathulate capsule, an inch long, $\frac{5}{16}$ inch wide at the widest end, dehiscing sharply, exposing 2 or more flat seeds $\frac{1}{4}$ inch across.

AGRICULTURAL NOTES.

Poultry Notes.

HOW TO IMPROVE BREEDING STOCKS.

Inasmuch as the average farmer does not keep poultry as his main business the problem for him to solve is how to improve his flock at least cost. There are three methods of procedure: (1) To buy a setting of eggs, (2) to buy a few hens and a cock, and (3) to buy a cock only. To buy a setting of eggs is usually the cheapest method. However, as eggs from very choice flocks are expensive the cost may be high, unless all the eggs hatch and no loss among the chicks is experienced. To buy a few 6-months-old pullets and a cock is a perfectly satisfactory but rather expensive method. Birds from highly developed strains are always expensive, but it is wiser to pay a high price for a few select birds than to buy a larger number that will prove undesirable. The same rule applies when buying a cock only. Such a bird, if obtained from a conscientious breeder, may be cheap at $25, and if an individual can not afford to buy it a community or a poultry club may do so. A choice male when mated with a flock of 20 hens, selected from the very best obtainable in the neighbourhood, will upgrade the stock in a very short time.

What breed to choose is so much of an individual question that it is difficult to give advice about selection. Undoubtedly on a poultry farm the most profitable bird is one of the egg breeds, since these are small and produce a large number of eggs in comparison with the little feed they consume. Feed is quite expensive in Porto Rico, and it pays to sell 9 eggs (1 pound) for 45 cents rather than live poultry at that price. On the average farm the heavier general-purpose breeds may be profitable, but even there the feed is by no means cheap. Moreover, the consumers are used to paying for poultry by the piece and not by weight. For this reason it will be more difficult, at least for some years, to sell the larger birds to good advantage.

As a rule the most practical method of improving the farm flock is to buy a purebred cock of a selected strain of one of the egg breeds and to mate him with 15 to 20 hens selected from the best native stock obtainable. Eggs from those hens should be the only ones allowed to hatch, and from the progeny the most desirable hens should be selected. These hens should be mated with a fresh purebred cock, or exchanged with another poultry club. The principal fact to be borne in mind is that a purebred selected male should always be used, but never one that is either father or brother to the hens.

How to select Breeders.

As egg production is at present more profitable than meat production, the directions here given for selection of breeding stock are intended to enable the poultry raiser to secure the largest possible number of eggs from the hens of his flock. Selection is absolutely necessary regardless of the breed. Any strain quickly deteriorates without rigorous selection.

The Egg Type.

The egg type is generally characterised by its long, graceful body. From the side, the neck and tail appear to be placed at an angle of 45° to the body. The back is long and straight. The breast is evenly curved from the head

to the legs. The general appearance is graceful, never heavy or dumpy. The vigorous bird of any breed, and not the small, inactive one, should be selected.

Heavy Eaters.

A hen of good egg type will produce eggs sufficient to pay for the feed she consumes; she must, however be a hearty eater, else she will not produce the maximum number of eggs. A hen may be compared with a machine used for manufacturing eggs. She is fed well, and in return is expected to be capable of giving the largest number possible of eggs.

Early Risers And Late Retirers.

In order to observe these points, one must "get up in the morning with the chickens." To know the worth of hens which are to be used for breeding purposes the caretaker or poultry manager must know all about them. Hens which go to roost early in the evening and stay until late in the morning are not desirable types. The hen that fills the egg basket is the early riser and late retirer.

Heavy Producers.

Production is the real test. A hen may be of the egg type, she may be large and vigorous, she may be a heavy eater and an early riser, and yet she may not fill the egg basket. Where there are large flocks of chickens it is impossible to determine the individual production of eggs unless one uses trap nests. On the farm, however, it is not an uncommon thing for the housewife and the children to know what the hens are doing.

Persistent Layers.

The good egg producer is the hen that lays persistently and frequently. The hen that has frequent or long-continued non-laying periods is not the one producing 200 eggs a year. There are hens which produce as high as 300 eggs a year. Inasmuch as a hen can not produce eggs and feathers at the same time, it is reasonable to conclude that the heavy producer has a short molting season; or, in other words, she starts to lay early in the season and keeps on until late. The hen producing eggs when eggs are high in price is, of course, the most profitable.

Mature Birds.

Mature birds are the only ones from which to select. Pullet eggs should never be used for hatching. The value of a hen can not be determined until she has been under observation for a long time. A pullet hatched early in the spring should begin to lay eggs in the fall. In that case she can be carefully watched until the next fall, when she begins to molt, and the spring after that, when she begins to lay again. If she ranks high in all the points discussed above, it is quite certain that her eggs will be superior to the average for setting. A keeper should not be discouraged if he finds but one hen in a whole flock, or even in a whole community, that grades high in all or most of the points mentioned. By hatching a few dozen eggs from that particular hen mated to a purebred cock, tha keeper may expect in a few years a strain of chickens that will produce many more eggs than he now gets.

The Male Bird.

The male bird should also be selected, whether it is purebred or mongrel. While it does not pay to use a mongrel male for breeding, this bird should, if used, be selected for egg type characteristics, the same as the hen. Under no consideration should a cock be used for breeding unless hatched from an egg laid by a selected hen. Where the flock is large an extra cock may be kept as a reserve, but otherwise all cockerels should be disposed of in the fall. It is a financial loss to keep them longer, as they have no influence upon the hens in regard to the number of eggs produced. The hens will lay as many eggs without the males, and the eggs will be of better keeping quality. The latter is of greater importance in Porto Rico than is generally realized. Eggs that are not fertilized will keep fresh for several weeks if kept in a clean, dry, and moderately cool place. Unfertilized eggs will also keep much longer than the fertile ones when a preservative is used.

Keep Young Birds Only.

A pullet hatched in April will usually begin to lay in November and continue laying through the winter. Next

fall she will go through her first molt, and begin laying again sometime during the winter. The following fall—that is, when she is $2\frac{1}{2}$ years old—she should be disposed of. Many poultry keepers in the States dispose of the hens the second fall; that is, when they are $1\frac{1}{2}$ years old. This, however, is not practicable on the farm. On the other hand, it is unprofitable to keep hens after they attain the age of $2\frac{1}{2}$ years. That rule does not apply to breeders of course. They are frequently not selected until in the third year, and they may be kept for several years if their progeny is satisfactory.

Sanitation.

On the farm sanitation means ordinary cleanliness; that is, clean drinking water, clean roosting places, and clean nest boxes. The roosting places should be cleaned and thoroughly whitewashed with lime every month. The nest boxes should be cleaned and the contents burned. It is good practice to hold the box over a fire so as to scorch the inside and thus kill germs and insects. In Porto Rico, where tobacco stems and waste from tobacco factories can be obtained cheaply everywhere, there is no reason for letting the poultry suffer from insects. Tobacco stems should be substituted for straw in the nest boxes, and tobacco dust should prove as good an insect powder as can be bought anywhere. Nothing is better than grease containing a few drops of kerosene to drive fleas from the heads of chickens. Carbolineum, or crude petroleum, thoroughly applied to the roosts, the interior of the chicken houses, and to the nest boxes, is an effective treatment for mites and ticks.

In the commercial poultry yard sanitation is the all-important problem. Undoubtedly most of the failures in Porto Rico can be traced directly to improper sanitation. The temptation seems to be to keep too many birds in one inclosure, or in several adjoining inclosures. This is a very dangerous and an unwise practice unless conditions are favourable and great precautions are taken. In the first place, the yard should be well drained, and the land made to slope so that the water will run off quickly. The

fence should be of wire, not boards and the fence posts should be of cement. The house should preferably be constructed of cement posts, with cement floors and galvanized-iron roofing. In addition, the house and yard should be shaded by rather large trees. Where several pens are close together they should be so located that water from one can not drain into another.

All pens must be carefully cleaned every week. The manure should be swept up and removed. The posts, roosts, etc., should be sprayed with a lime whitewash, and the ground should be well sprinkled with powdered lime. A sick bird should be promptly removed to an isolated pen, and a dead one should be immediately burned. In case of an epidemic the birds should be removed, each pen separately, to some new location, and their old pens should be disinfected with crude carbolic acid or some other strong disinfectant.

—*Porto Rico Experiment Station. Circular 19.*

LOSS OF CITRIC ACID IN LIMES AND LIME JUICE.

During his recent visit to Dominica, Mr. S. M. Davis Chief Chemist to Messrs. Rowntree & Co., the Cocoa Manufacturers of York, found an opportunity to make certain investigations concerning the loss of citric acid which may occur in lime and in lime juice under certain conditions; he has placed these observations at the disposal of this Journal in the hope that they may be of interest to lime growers in Dominica and elsewhere.

(1) *Loss of Citric Acid in Rotten Fruit.*—Sets of fifty limes of various degrees of ripeness were hand pressed, the juice from each set measured, and its acidity determined. This gave data for calculating appoximately, the weight of acid that a barrel of each type of fruit would yield.

Thus—Ripe yellow limes yielded		5·3lb citric acid per barrel.
Yellow green limes ...	...	4.9 " " "
Overripe limes ...	...	4·6 " " "
Green limes ...	...	4·4 " " "
Mushy, rotten limes...	...	1.7 " " "

It may be noted that yellow green limes give the clearest and most acid juice, but a smaller content than fully ripe ones. The overripe limes gave, of course, a thick juice, and the mushy, rotten, limes, a pulp from which it was difficult to strain even a thick juice. Note the enormous destruction of citric acid that takes place: fully two thirds of the original content has disappeared.

(2) *Losses of Citric Acid on Storing Lime Juice.*—Two hundred pounds of second roller juice, fresh from the rolls was run into a half tub, to a depth of 11 or 12 inches. It was allowed to stand under cover with no disturbance of the scum, except that caused by continually lifting the tub on to a platform scale, from time to time, to determine the loss of weight by evaporation. At the same time the acidity of the juice was determined.

The experiment had to be discontinued on the nineteenth day. During this time, the 200lb of juice was reduced to 184lb by evaporation, and the original acidity of 12·1oz. to 11·3oz, equivalent to 10·4oz, on the original volume. Thus a loss was recorded of 1 7oz citric acid per gallon in nineteen days, representing 14 per cent. of the original acid content.

In addition to the scum of pectous matter and essential oil, the usual thick skin of *Sacch. mycoderma* formed on the surface. Under the microscope a lively growth of mycoderma was seen to be accompanied by a considerable growth of bacteria. The action of mycoderma on citric acid, as is well known, results in its eventual decomposition into carbon dioxide and water. Bubbles of the gas formed freely under the skin and broke at the surface of the juice.

Under the conditions described it seems therefore safe to say that during the first few weeks of storage, the loss of citric acid is of the order of five per cent. per week of the original content. In deep storage tanks, with large volumes of juice covered by a thick mass of scum, the evaporation would certainly be less, and the loss of the citric acid less; but it seems extremely unlikely that the loss would be reduced to a negligible quantity Storage of the juice for such long periods as three or four months, must result in a big loss to the planter. —*Agricultural News.*

NOTES ON POULTRY DISEASES.

Never overfeed;

Give good, plain food;

Never allow the birds to become fat; make them take plenty of scratching exercise;

Give plenty of green food;

Give as much thick separated milk as the birds will take;

Always have before them abundance of clean, cool fresh water;

Always see that they have abundance of grit and charcoal of a suitable size constantly before them;

Give them clean, well ventilated, but not draughty houses to live in;

See that the houses are rain-proof, never damp, and admit the sun's ray into all parts;

Keep the birds free from insects by occasional dipping;

Also spray the houses occasionally and so keep them free from insects;

Never waste time and money, in attempting to cure a sick bird, but kill it and burn the carcase;

Never breed except from the healthiest, strongest, and most vigorous birds;

Never under any circumstances breed from a bird that has been ill and been cured;

Hatch well and rear the chicks well, and never allow them to have any set-backs;

Exercise every care when buying fresh stock; examine it very carefully, and dip every new bird; isolate it for a week, and dip it again before putting it with your own stock. —*Rhodesia Agricultural Journal.*

OUR MILK SUPPLY.

A comparison with the results in Trinidad.

By C. B. W. ANDERSON, Asst. Analyst, Government Laboratory, British Guiana.

In the January number of the Trinidad and Tobago Agricultural Journal a paper read by Mr. Shrewsbury, Government Analyst, on the Trinidad milk supply, before the Society on the 13th January, is reproduced.

It will be interesting to make a comparison of the figures there shown and those of our own.

First we will make a comparison between the two standards in the following table:—

TABLE I.

	Fat.	Solids-not-fat.
English standard	3.0	8·5
Trinidad	3·0	8·5
British Guiana	3·25	8.5

From this it will be seen that the Trinidad and English standards of fat are similar, whereas the Colony's is slightly higher. The Colony standard was fixed by Professor Sir J. B. Harrison many years ago, as a result of hundreds of samples collected from all parts of the Colony of known genuine quality. This result is borne out by the table for 1917-1920 shown in the latter part of this article.

The following table is a comparison of the number of samples examined in each Colony during the period 1917-1919 with the extent of adulteration :—

TABLE II.

Years.	British Guiana.	Trinidad.
1917	1,612	
1918	1,675	2,427
1919	1,520	
	4,807	2,427

ADULTERATION.

Years.	Trinidad.	British Guiana.
1917	10.4	15.4
1918	10.4	15.4
1919	9.4	12.1

It is peculiar that the rate of adulteration remained the same in each Colony during 1917 and 1918.

The greater rate of adulteration in B. Guiana may be due to the following reasons :—

1. The quality of our milk is appreciably lower than that of Trinidad, which is disproved by Tables IV, V, VI, VII.

2. The lower standard of fat by law in Trinidad.

3. The percentage figures for this Colony being more reliable than that of the neighbouring Colony owing to the much larger number of samples analysed.

4. The number of samples analysed may not be an indication, as this may be due to our milk supply being in the hands of a larger number of vendors.

Even taking all these points into consideration we can safely say that the rate of adulteration is higher in British Guiana.

The half year 1920 shows an increase of the percentage of adulteration in the Colony to 17.5. Vide—Table IX.

TABLE OF THE STANDARDS OF FAT IN VARIOUS COUNTRIES.

TABLE III.

(Taken fr m the Trinidad Agricultural Journal.)

COUNTRIES.	STANDARDS OF FAT.
Trinidad	3.0
British Guiana	3.25
Holland	2.5
Paris	2.7
Amsterdam	3.0
Great Britain	3.0
New York	3.0
Omaha, U.S.A.	3.0
Pennsylvania	3.0
Lansing, U.S.A.	3.0
Columbus, U.S.A.	3.1
Philadelphia	3.5
Canada	3.5
Burlington	3.5
Minnesota	3.5
W.S. Treasury Dept.	3.5
Des Moins, U.S.A.	3.5

The low percentage in Holland is due to the low quality of fat in milk from a particular breed of cattle.

Mr. Shrewsbury shows that the mean rate of fat in Trinidad for the years 1917—1919 was 4.2, inclusive of adulterated samples, the highest case being one of 56 per cent. added water, or as low as 1.0 per cent. of fat.

The following table shows the figures for this Colony of official samples received from the Public Health Departments and Police with the exception of Berbice as worked out month by month during 1917—1920.

TABLE IV. 1917.

Months.			No. of Samples.	Average fat in Genuine and D. P.	Average fat in Genuine and Ad.
January	...	...	142	4·14	4·00
February	...	...	164	4·04	4·00
March	...	...	150	3·84	3·73
April	...	...	140	3·91	3·74
May ...	...	...	158	4·08	4·00
June...	...	...	148	4 05	3·90
July...	...	...	60	4·30	4 21
August	...	...	136	4 34	4·13
September	...	..	152	4·05	3 94
October	...	...	33	4·15	4·00
November	...	...	150	4·30	4·03
December	...	...	146	4·10	3·80
			1,579	4·09	3.95

TABLE V. 1918.

Months.			No. of Samples.	Average fat in Genuine and D. P.	Average fat in Genuine and Ad.
January	...	...	59	3.97	3·87
February	...	...	164	4 12	3·90
March	...	...	161	4·05	3·82
April	...	...	153	4·13	3·84
May...	...	...	123	4.09	4·03
June...	...	...	174	4·08	3·76
July...	...	...	141	4·08	3 94
August	...	...	135	4·00	3·90
September	...	...	156	4·15	4·00
October	...	...	93	4·37	4·26
November	...	...	150	4·22	4·10
December	...	...	90	4·24	4·00
			1,599	4·08	3·92

TABLE VI. 1919.

Months.	No. of Samples.	Average fat in Genuine and D. P.	Average fat in Genuine and Ad.
January	120	4·20	4·08
February	175	3·94	3·85
March	115	4·10	3·90
April	95	3·90	3·74
May	150	4·17	3·95
June...	128	4·12	4·00
July	104	4·33	4·27
August	117	4·04	4·06
September	116	4·33	4·20
October	112	4·20	4·05
November	112	4·[illegible]8	4·22
December	113	4·41	4·30
	1,457	4·17	4·02

TABLE VII. 1920.

Months.	No. of Samples.	Average fat in Genuine and D. P.	Average fat in Genuine and Ad.
January	142	4·37	4·20
February	117	4·21	4·06
March	102	4·27	4·14
April	113	4·12	4·00
May	144	4·22	4·08
June...	128	4·24	3·92
July	112	4·51	4·20
August	136	4·50	4·32
September	103	4·27	4·06
October	131	4·13	3·90
November	118	4·21	4·00
December	158	4·13	3·83
	1,524	4·27	4·00

TABLE VIII.

YEARS.	Genuine and D.P.	All Samples.	Average fat in Genuine and D,P. 1.	Average fat in Genuine & adulterated. 2.
1917 ...	1210	1579	4·09	3.95
1918 ...	1356	1599	4·08	3.92
1919 ...	1329	1457	4·17	4.02
1920 ...	1286	1524	4·27	4.00
		6159	4·15	3.99

From these tables you can form a supplementary table viz. :—

AVERAGE FAT IN GENUINE AND ADULTERATED MILKS.

Trinidad	...	4.2	(1917-1919)	
British Guiana	...	3.99	(1917-1920)	Ref. table viii.
England	...	3.7		

Table VIII shows that the average fat for all samples has increased during the last two years.

As a true indication of the approximate average fat in B. Guiana, it would be more accurate to use the figures indicated in 1 Table VIII, as this represents an average from Genuine and D.P. samples and elliminates the obviously adulterated samples. This shows that the standard in this Colony is also not too high.

If these were worked out on only genuine samples the average fat would be well over 4.2%.

TABLE IX.

RATE OF ADULTERATION MONTH BY MONTH DURING YEARS 1917—1920.

MONTHS.	1917.	1918.	1919.	1920.
January ...	18.3	6.7	8.3	18.3
February ...	17.0	15.2	8.5	14.5
March ...	10.6	12.4	14.7	12.7
April ...	17.1	13.6	12.6	23.9
May ...	13.3	11.4	16.0	16.0
June ...	14.8	29.3	10.1	22.6
July ...	11.6	17.7	4.8	26.7
August ...	15.4	11.1	10.2	9.5
September ...	13.1	16.0	8.6	15.5
October ...	21.2	10.7	17.0	22.1
November ...	16 0	12.6	8.0	25.4
December ...	23.3	16 6	18.5	26.0

This table shows that on the whole the rate of adulteration from month to month does not vary very considerably, but it is noticeable that December contains very high percentages in all the years. This is probably due to the increased demand for milk during the Christmas Season.

During these four years the following cases of high percentage of fat have occurred :—

February, 1918	...	...	11.% Fat
September ,,	...	...	13. ,, ,,
January, 1920	...	...	11. ,, ,,
July ,,	...	...	17. ,, ,,
August ,,	...	...	19. ,, ,,
September ,,	...	...	13. ,, ,,

At least six cases of over 10% fat were also noted in addition to those shown above.

The remarkable case in August, 1920, of a sample of milk received from Cane Grove containing 19·0% fat is worthy of note and it would be interesting to know whether this amount has been exceeded anywhere in the West Indies.

The following are the worst cases of adulterated milk during the period:—

January, 1917	...58·3 per cent.	Fat abstracted	
June, 1918	...90·0 ,, ,,	,, ,,	
February, 1919	...64·0 ,, ,,	,, ,,	Water added 57 per cent.
June, 1919	...56·0 ,, ,,	Fat abstracted	
August, 1919	...60·0 ,, ,,	,, ,,	
August, 1920	...56·9 ,, ,,	,, ,,	
November, 1920	...77·0 ,, ,,	Water added	
December, 1920	...62·0 ,, ,,	,, ,,	

These cases cited prove how callous the milk vendor is towards the health and happiness of his customers In many cases I think it is not a question of water added to milk but of milk added to water.

TABLE X.

Samples of milk during 1917-1920 of 5 per cent. and over and between 4-5 per cent. fat.

Percentages	*1917*	*1918*	*1919*	*1920*	*Total.*
4—5%	523	519	555	588	2,185
5% and over	183	190	212	196	781
					2966

Of the 6,119 samples examined no less than 2,966 were over 4%. This is equal to a percentage of 48·4 (includes adulterated samples.)

Notice must be taken of the increased rate of adulteration for 1920, the rate nearly doubling itself, yet in spite of this the average per cent. of fat in all samples has remained at 4·00% viz. VIII. It will be remembered that the price of milk was under control of the Government and therefore vendors tried to make greater profits by adulterating these milks.

During the whole of 1920 and the half year 1919 this control was in force and table XI shows the remarkable difference in the rate of adulteration before and during the control and the three months that have elapsed since milk was decontrolled.

Before Control.

1917	15·4 per cent.
1918	15·4 per cent.
1919 (Jan.-Feb.) ...	8·4 per cent.

During Control.

1919 (Mar. to Dec.) ...	12·9 per cent.
1920	19·5 per cent.
1921 (Jan. to Feb.) ...	12·8 per cent.

After Control.

1921 (Feb. to May) ...	9·7 per cent.

It is seen that during the two periods 1919, the rate of adulteration increased as in the latter period Government control was in force. 1920 shows a considerable increase in the adulteration figures and this can be accounted for as follows:—It was during 1920 that the prices of all foodstuffs reached its maximum and therefore the temptation to adulterate and make larger profits was greater, and as the price was controlled the only alternative was to sell mixed milk by the addition of water. During this year, butter was also at a prohibitive price and therefore many dairies increased their manufacture of this article with a consequent temptation to the vendor to abstract his fat and yet still sell his abstracted milk at the highest price. This must have been a profitable business.

Since the decontrol this year there has been a very considerable reduction in the rate of adulteration. Sammy* now has his own way and it is hoped that as he becomes more educated in milk practice there will be a better quality and cleaner milk on the market in future.

Mr. Reid proved in the Journal of the Board of Agriculture of British Guiana Vol. xii. No. 3 that the quality of milk is not appreciably affected by scalding; the mean of his results showing that the S.N.F. is increased by 0·36% and the fat decreased by 0·14%.

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* Popular Nickname for the East Indian Labourer.

A vendor cannot plead that by scalding his milk the fat has been reduced to any extent below 3.25, for let us say his milk contains 3·5 before scalding, then after it would still contain at least 3·25% and therefore no prosecution would take place.

When a true case of genuine milk is found below the quality fixed by law it is invariably due to the following reasons :—

1. Improper feeding of the cow.
2. The diseased condition of the animal.
3. Bad milking.
4. Milk should be thoroughly mixed each time a sale is made otherwise the fat rises to the surface and the first sales will be of a relatively high fat content and the last poor.

A clear instance is given by Mr. Shrewsbury in his article proving the third reason, viz. :—

Improper Milking.

Calves were frequently permitted to suck both "before and after milking. This was a bad practice "because the fore milk was much poorer in fat than the "strippings, as shown by the figures next quoted."

Per cent. Fat.

	Cow I.	Cow II.
First Pint	0·7	1·0
Last Pint	10·8	9·0

Cow III.

Portion	1	2	3	4	5	6
Per cent. Fat	1·7	1 8	2·1	2·5	3·1	4·1

It will be interesting to quote another paragraph of Mr. Shrewsbury's article as follows :—

"It had been said that the Indians took great care "of their cows and it was no fault of theirs if the animal "gave poor milk. The speaker heartily agreed and was "anxious to add that the Indians *selected* their cows and

"that the chance of one of these animals yielding milk "with less than 3·0 per cent. of fat was very small indeed, "much less even than the chances in England which were "1 in 12,000. There had been confusion about this "figure. It simply meant that from the results of a large "number of analyses it was calculated that there was a "possibility of one cow in 12,000 giving milk containing "less than 3·0 per cent. fat. This figure had been con- "fused with the percentage of adulteration of milk in "Trinidad, which also however, indicated that the "standards were not severe."

Vendors must be careful of all these points for carelessness is just as much a crime when it affects the health of the community as deliberate adulteration.

THE PRINCIPAL VARIETIES OF SUGAR CANE UNDER CULTIVATION IN BRITISH GUIANA DURING 1919, 1920, 1921.

By the Director of Science and Agriculture and the Secretary of the British Guiana Sugar Planters Experiment Stations Committee.

The following table shows the areas occupied by the principal varieties of canes under cultivation for the crop of 1921 compared with those of 1919 and 1920.

PRINCIPAL VARIETIES OF CANES 1919, 1920, AND 1921, AREAS IN BRITISH ACRES.

Variety.	1919	1920	1921	Increase or decrease on 1920.	
	Acres.	Acres.	Acres.	Increase	Decrease
D.625	34,142	36,100	37,240	1,140	
Bourbon	3,465	2,926	2,337	—	589
D.625 mixed with Bourbon and other seedlings	7,806	8,561	9,150	589	—
D.145	4,667	5,183	4,935	—	248
D.118	2,676	3,608	3,152	—	456
B.208	3,601	3,118	2,254	—	864
D.419	1,675	1,887	1,688	—	199
R.P.8	485	563	891	328	—
Diamond 185 ...	930	1,174	861	—	313
Green Transparent ...	1,131	976	752	—	224
Java Seedlings ...	507	903	682	—	221
D.109	388	470	297	—	173
Ba.6032	112	155	210	55	—
B.376	394	344	206	—	138
Diamond 37	106	130	132	2	—
B.H.(10)12	34	69	131	62	—
D.167	138	123	99	—	24
B.147	186	101	87	—	14
R.P.21	97	119	67	—	52
D.4395	—	—	66	66	—
D.179	63	60	60	—	—
R.P.20	—	—	55	55	—
D.216	83	90	53	—	37
B.6450	58	47	39	—	8
B.3412	—	—	33	33	—
R.P.73	150	69	32	—	37
D.199	42	3	30	27	—
R.P.23	77	40	23	—	17
D.4399	13	24	14	—	10
D.4397	29	9	4	—	5
R.P.1	72	22	—	—	22
Small areas of other varieties and areas under varieties unenumerated.	10,687*	614	289	—	325
TOTALS	73,814	67,488	65,869	2,357	3,976

*Note :—Principally turn-overs for subsequent crops.

The following table indicates the relative distribution of the various kinds of cane during the crops of 1917, 1918, 1919, 1920 and 1921.

Variety.	For Crops of				
	1917	1918	1919	1920	1921
D625	48.2	47.9	46.2	50.9	56.5
Bourbon	9.4	6.4	4.7	4.1	3.5
D145	7.9	7.7	6.3	7.3	7.5
B208	6.4	5.9	4.8	4.4	3.4
D625 mixed with Bourbon & other seedlings. ...	5.4	10.2	10.6	12.1	13.9
D109	1.1	0.4	0.5	0.7	0.5
Diamond 185 ...	1.8	1.5	1.1	1.7	1.3
Green transparent ...	1.9	1.7	1.5	1.4	1.1
D.118	2.1	3.5	3.6	5 1	4.8
D.419	1.6	1.8	2.3	2.7	2.7
Java Seedlings ...	...	0.8	0 7	1.4	1.0
Providence 8 ...	...	0.5	0.7	0.9	1.6
B.376	...	0.4	0.5	0.5	0.3
B.H. (10) 12 ...	...	...	...	...	0.2
Diamond 37 ...	...	...	...	...	0.2
Other varieties unenumerated. ...	14.2	11.3	16.5	6.8	1.5
	100.0	100.0	100.0	100.0	100.0

From the returns supplied by the sugar plantations, the distribution of the various sugar canes in cultivation for the crops of 1917, 1918, 1919, 1920 and 1921 according to their orgiin are as follows :

	1917	1918	1919	1920	1921
Bourbon and other old varieties ...	16.7	13.0	13.1	8.9	8.8
Java	0.4	0.8	0.8	1.4	1.1
Barbados	7.1	6.7	5.9	5.7	4.4
British Guiana { Plns. Diamond & Providence ...	2.7	2 6	2.6	3.2	3.3
British Guiana { Botanic Gardens	73.1	76.9	77.8	80.8	82.4
	100.0	100.0	100.0	100.0	100.0

The average yields in tons of commercial sugar per acre of the principal varieties under cultivation for the crops of 1920, as deduced from the returns supplied by the managers of the sugar plantations were as follows:—

CROPS OF 1920.

	Java.		Bourbon.		D 118.	
	Yields.	Acreage.	Yields.	Acreage.	Yields.	Acreage.
Mean of all plantations ...	1·99	849	1·75	2373	1·72	2462
Maximum reported ...	3·00	5	3·44	39	2.35	7
Minimum reported ...	1·46	290	0.97	123	0·74	13

	D 625		B 208		D 419	
	Yields.	Acreage.	Yields.	Acreage.	Yields.	Acreage.
Mean of all plantations ...	1·66	24,692	1·66	2797	1·66	685
Maximum reported ...	2·5	321	2·00	7	2·38	3
Minimum reported ...	0·873	854	1·27	12	1·14	7

	◇ 185		D 145		G Trars.	
	Yields.	Acreage.	Yields.	Acreage.	Yields.	Acreage.
Mean of all plantations ...	1.64	704	1 61	3893	1·53	253
Maximum reported ...	1·98	561	2·48	86	1·85	44
Minimum reported ...	1·31	89	0·73	37	1·20	15

	Mixed.		Ba. 6032.		B.H. (10) 12	
	Yields.	Acreage.	Yields.	Acreage.	Yields.	Acreage.
Mean of all plantations ...	1·63	11,476	2.44	62	2·35	57
Maximum reported ...	2·13	358	2.79	28	2·80	49
Minimum reported ...	1·01	264	2·10	34	1·90	8

	D 216		B 6450		D 167	
	Yields.	Acreage.	Yields.	Acreage.	Yields.	Acreage.
Mean of all plantations ...	2.09	31	1.77	23	1.81	117
Maximum reported ...	3.00	5	1 99	9	2.14	39
Minimum reported ...	1.45	3	1.63	6	1.32	64

	D 109		B 376		B 147	
	Yields.	Acreage	Yields.	Acreage.	Yields.	Acreage.
Mean of all plantations ...	1.67	324	1.57	331	1.49	97
Maximum reported ...	2.07	44	1.63	4	1.90	40
Minimum reported ...	1.35	37	1.50	327	1.08	57

The following tables indicate similar figures as the preceding but they are compiled from the returns supplied by the larger plantations only.

	Java		Bourbon		D 118	
	Yields.	Acreage.	Yields.	Acreage.	Yields.	Acreage.
Mean, larger plantations only	1.99	849	1,91	1230	1.81	2149
Maximum reported ...	[illegible].00	5	3.44	39	2,35	7
Minimum reported ...	1.46	290	1.28	327	1.12	4

	D 625		B 208		D 419	
	Yields.	Acreage.	Yields.	Acreage.	Yields.	Acreage.
Mean, larger plantations only	1.82	17,568	1.66	2797	1.66	685
Maximum reported ...	2.53	321	2.00	7	2.38	3
Minimum reported ...	1.20	705	1.27	12	1.14	7

	◇ 185		D 145		G. Trans.	
	Yields.	Acreage.	Yields.	Acreage.	Yields.	Acreage.
Mean, larger plantations only	1.64	704	1.80	3730	1.55	246
Maximum reported ...	1.98	561	2.48	86	1.85	44
Minimum reported ...	1.31	89	1 14	14	1.20	15

The result of large scale field-trials with other varieties on the sugar plantations are shown in the following table :—

Variety.	Acreage.	Yield.
Diamond 35	13	2·84
P.L. 374	19	2·77
P.L. 264	20	2·45
Diamond 581	7	2.45
B. 3,412	31	2·36
P.L. 254	20	2·31
R.P. 8	420	2·30
D. 433	7	2.30
R.P. 73	56	2.29
Diamond 37	48	2.15
D. 246	1	2.14
R.P. 21	95	2·07
B. 3,922	9	1·99

SOME LOCAL PRACTICES PREVALENT IN SOUTH INDIA IN THE CONTROL OF INSECT PESTS.

The following extract from the above paper by the Assistant Entomologist of Madras which was read at the Nagpur Session of the Indian Science Congress, 1920, and which appeared in the Agricultural Journal of India, Vol. XVI., Part. I. we reproduce here as being of considerable interest to local agriculturalists and also possessing some hints of value.—EDITOR.

With regard to the various local beliefs entertained by villagers as to the causes that bring about insect outbreaks, we can find, unfortunately, very little of scientific tinge in them. The chief of these are God's curse, the alleged bad position of the planets for the season and the prediction of a local oracle or astrologer, the displeasure of a particular village deity who was not properly propitiated, a neighbour's black art or evil eyes, the approach of a polluted man or woman, a bad wind, floods, sudden and unexpected changes in the weather, and a number of other causes real and supernatural. It need hardly be stated that, with the exception of some of these which are quite evident, few of the above would generally appeal to scientific men and could therefore be brought within the realm of practical politics. However, one or two interesting points with regard to some of the prevailing local beliefs on the origin of crop pests may be mentioned here. The appearance or disappearance of insect pests is very often associated in different parts of South India with the appearance and the direction of the winds; this is especially the case in the delta tracts of Godaveri and Kistna; the *payirgali* and the *thoorpugali* have their own significance and are regarded as very important by the agriculturists. A good deal of stress is also laid on the time of sowing particular crops to avoid pests, and I have heard from

experienced and educated ryots that in some cases early sown fields, and in others late sown ones, suffer from pests. Such beliefs are entertained in many places and are probably the conclusions of years of experience, and as such we are not yet in a position to belittle them though convincing scientific explanations for such phenomena have not yet been found out to confirm such views.

Now, coming to the control measures adopted, we might consider these under the following convenient heads :—

Religious or faith cures.

In most villages many of the farmers, believing as they do in supernatural causes of insect outbreaks, naturally do nothing; they think that the curse of God should run its natural course. At the same time there are others who resort to faith cures such as charms, *mantras*, magic, and so on, in the belief that the curse may be avoided or cleared. Most of these methods consist in getting the professional local soothsayer or magician to perform some ceremonies to drive the pest and save the crop. While once in the South Arcot-District in connection with the study of the leaf miner (*Surul*) pest of groundnuts, I came across a professional pest driver who reluctantly wrote me out a Sanskrit couplet, which he told me in confidence was very effective in checking pests. The verse is to the effect that all sorts of pests can be driven by means of a talisman prepared and fixed by an individual born of a particular *gotra* or sect among *dwijas* or the twice-born. The procedure consisted in this man preparing three small slips containing the verse written down and having these buried at the three corners of an infested plot on a Sunday morning. It is believed that the pest clears out through the fourth corner of the plot. I have given this one instance just to give an idea of some of these ludicrous methods in vogue. I am told that in parts of Cochin and Travancore, when paddy fields are infested with pests like the rice-bug, etc. Christian ryots often resort to the method of sprinkling on the infested fields sanctified water obtained from Catholic priests. To ward

off the effects of the evil eye which is said to produce injury or disease to crops and in which many literate people have faith, there are curious devices employed in different places. Very often a field with a promising crop, if it happens to be situated by the side of a thoroughfare, is often protected from the evil eye by the prominent exhibition of some curious object in the middle of that plot, such as a skull, a dead crow, a stuffed figure of an unnatural man or woman, a painted pot on a pole, etc.

In gardens where betel vines and grapes are grown, visitors are not usually allowed admission, and in the former case never with one's shoes on. While inside a betel vine garden once in the Tanjore District, where I was reluctantly allowed admission by the owner, I just overheard a conversation to the effect that no higher caste man should be allowed into a betel vine garden, because the garden will suffer from the evil eye. Some of the local methods reported to be resorted to in villages in some parts of the North Arcot District against caterpillar pest on paddy were the sacrifice of a goat to the village deity and making cooly girls perform a ceremonial dance near the infested field. The various harvest festivals called *pongals*, *pujas*, etc., performed as thanksgiving for a good crop, and prayers for a future good crop, are also said to have some significance in keeping off insect pests.

In spite of the funny and curious nature of many of these methods, many cultivators still have faith in these cures and cling to those practices. One reason for this, so far as I have been able to make out, is this: In some cases of pest outbreak, such as swarming caterpillar, the time of the sudden disappearance of these creatures into the soil or otherwise due to their peculiar habits synchronizes with the apparent inactivity period soon after some faith cure is adopted.

We will now come to consider other local methods which appear to be of a practical nature. Though many of these are carried out in most cases without the know-

ledge on the part of the ryots as to their bearing on insects or on their habits, some of these practices have been found to produce the desired results.

Cultural Methods.

Weeding. Very few farmers will admit that they carry out this process of weeding to check insects; but in effect this method goes a good way in checking insect pests. I know that in parts of South Kanara, in the villages along the Ghâts, where the rice-bug is a bad pest, the cultivators believe that periodical burning of the jungle grass around their paddy fields reduces the pest considerably, and there is a good deal of scientific truth underlying the same.

Flooding. In parts of the Godaveri Delta, flooding of paddy fields is adopted to check swarming caterpillar (*Spodoptera*) attack. In some villages of the Coimbatore District, the same method is resorted to in betel vine nurseries where the young *Sesbania* (*agathi*) plants are attacked by the caterpillar *Prodenia*. In both these cases, the result is effective and brings up the caterpillars which become a prey to insectivorous birds of sorts.

Draining of water. This is believed to check rice Hispa in some villages of South Kanara. I have also read of this practice in parts of Bengal for the same pest. I am not quite sure as to whether this practice does not prevail in some places in the treatment of the rice-case worm (*Nymphulla*) also.

Selection. In the well-known tabacco areas in the Godaveri *lankas*, before the seedlings are transplanted into the fields from the nurseries, there is a system of weeding out sickly seedlings and those that show a sort of swelling at the stem which is caused by the stem-borer of tobacco (*Phthorimæa heliopa*); many of the tobacco growers are familiar with the pest and this sort of selection is found to do immense good. But what unfortunately lessens the good effect of this intelligent measure is the rather imperfect way in which the discarded seedlings are disposed of; they are not destroyed but left on the field bunts, thus

helping many of the borers in these stems to live on and infect healthy fields.

Growing of mixed crops. Just as weeding, this is also a very well-known and common practice in many dry land tracts, and, as in the case of weeding, it is doubtful whether the cultivator ever thinks of insect pests in this connection. However it be, there is no doubt that this mixed cultivation of different crops certainly contributes its own share in reducing insect pests.

Seasonal ploughing. Though this is not done regularly with special reference to the control of insect pests, in most cases there is no doubt that this method has its own insecticidal value—especialy when it is done after an attack of hairy caterpillars, grasshoppers, cockchafers or cut-worms. In South Kanara when small plots of paddy are badly infested with Hispa in the third crop plots, the farmers plough up the fields and sow pulses.

III.—Mechanical methods.

In different parts of the country when farmers find that their infested fields are still bad in spite of all faith cures and agricultural methods, they resort to the trial of various Mechanical and other methods of a practical nature. Among these are :—

Netting, bagging, etc. For pests like locusts, rice-bug, swarming caterpillar, etc., it is a well-known practice in parts of Malabar and Travancore to destroy these by collecting them in bags, nets, winnows, etc. Though worked on the same principle, the contrivances are of various kinds. In some places paddy winnows are used, in others a sort of bamboo winnow with a long handle is used. I have also seen caterpiliars being swept by brooms into baskets and ordinary bamboo umbrellas used as bags to collect very young green caterpillars (Plate V, fig. 3). In one place in the Coimbatore District, where paddy seedlings were badly infested with surface grasshoppers of sorts, I found that the farmers used to drive the hoppers to one corner of the plot and beat them to death by means ot palmyra leaves, their long stalks being used as handle. Cotton clothes used as upper clothes or headgear by the

ryots are also improvised many a time to serve as sweeping bags and worked by two or more men,

Smoking and burning. In parts along the Malabar Coast, a system of creating smoke to drive away the rice-bug is found. The same method is adopted in other places to drive away blister beetles which damage cereals in flower.

The nests of troublesome wasps and bees are also often scorched by a burning torch, generally at night.

Other mechanical methods. To check the rice-case worm in paddy fields, it is a custom, chiefly in parts of North Malabar to drag a thorny tree branch across the infested field, which makes the small cases of the worms drop down into the water. This is also said to be practiced in the North Arcot District for leaf caterpillars like *Melanitis*, etc.

The covering with muslin or paper bags of ripening fruits of good varieties of pomegranates, mangoes etc., is a practice in many gardens all over the country and this certainly have some deterrent effect upon fruit-borers like borer caterpillars and fruit flies.

The use of ant pans in houses to keep away ants from sugar-jars, meat-safes, dairy products, etc., is quite an old custom, as may be seen from the crude granite ant pans used by silk farmers in Mysore, to protect their *mejas* containing silkworm trays.

The hooked wire is commonly used in parts of Tinnevelly to extract the rhinoceros beetle from coconut shoots.

A very interesting and intelligent method of catching winged termites is in vogue in parts of the Coimbatore District. It is, of course, done not with the idea of destroying the pest, but with the purpose of collecting them in numbers for edible purposes. It is probably not very widely known that some of the low caste cultivators regard the winged termite as a delicacy ; during certain seasons these are sold in bazaars of different towns. I have also heard that among some castes this substance forms one of the important articles of dowry for a bride! Though resorted to for edible purposes, it must be admitted that this method checks the multiplication of this undesirable insect to some extent. The procedure is as follows :—

Just before the usual season when these winged termites emerge, and which the professional catcher knows, a shallow pit is made close to a termite mound and this is filled with water; this pond is enclosed on three sides by a sort of fencing, the side adjacent to the mound being kept open. A small lamp is lighted and placed at the edge of the pond. After all this paraphernalia is arranged, the catcher sprinkles some water over the termite mound and in a few minutes swarms of winged termites emerge. These naturally hover about the light and drop into the artificial pond, when they are collected by the operator.

In the Ghât regions along the Western Ghâts, and in the Nilgiris and Mysore, it is a pretty common sight to see the bulls of hill carts having suspended from their neck a big brush-like tuft of wool generally black in colour. I have tried to get the meaning of this extra ornament from cart-drivers, but have been told that they are charms to protect the bulls from diseases. Whatever it is, I find from what I have observed that this tuft of wool keeps away to a considerable extent the biting flies that worry cattle in these hill tracts. Any one travelling in these tracts will notice the havoc done by these flies to cattle, and I am led to think that this tuft of wool is an effective preventive against fly pests.

IV.—Medicinal methods.

We might now examine some of these methods which more or less correspond to what entomologists call insecticidal methods.

The commonest practice in vegetable gardens against insect pests of all kinds, no matter what their habits are, is the use of ashes. It will be found used for brinjal fruit and stem borer, *lablab* aphis, cucumber fruit fly, brinjal *epilachna* and many a common vegetable pest.

Once in a village in the Salem District, I saw ordinary white-washing lime being splashed on *lablab* vines against plant-lice.

An improvement in the meehanical method of smoking is found in the following two cases where some extra effect is attempted to be produced by smoking special

materials. In the Adoni Taluk, the smoke is produced by burning hides and hoofs of cattle to drive away blister beetles attacking dry crops; in the Dharmapuri Taluk of the Salem District, on the other hand, there is the curious system of burning pig's fat to fumigate a field infected with rice Hispa. There is no doubt that some temporary relief is got by creating smoke, but this latter system of using pig's fat does not show any appreciable effect on the rice Hispa. Speaking of the method of smoking, many of us are, I believe, aware of the burning of frankincense and resinous gums in houses to keep away mosquitoes; but I don't know whether burning and creating smoke with the dung of elephants and horses for mosquitoes is so very widely prevalent, I have seen this in parts of Malabar, Anantapur and Cochin.

Banding with art of posts and trees against termites and the use of kerosine against ant nests in buildings, are methods too well known to demand any special remark. Climbers, when they go up trees like mango infested with the troublesome red ant (*Ocophylla*), often carry with them pouches containing ashes which they splash against trains of ants on the tree branches.

I have seen in some parts along the West Coast that fermenting starchy liquids are exposed in coconut gardens and this is found to attract chafer beetles of all sorts, including the coconut rhinocerous beetle.

It is reported that the use of the powdered cake of the fruit of the Maravitti tree (*Hydnocarpus wrightiana*) checks this coconut beetle and is said to be used in parts of Travancore.

Apart from the manurial value of several oil-cakes applied by farmers to growing crops, such as *nim* (*Melia*) castor, groundnut, some of these possess some insecticidal value of their own, though how far the farmer realizes it is a doubtful point.

In many interior villages different kinds of vegetable drugs are being used in various ways in the belief that

they check pests; though many of these are of doubtful value, there are some which show promise of efficacy and which are therefore worth trial at the hands of scientific men.

In different parts of the country stored products, especially grains, are preserved in bins together with the leaves of *nim* (*Melia*) or *nochi* (*Vitex nojinda*) plants; the latter I have seen in parts of South Arcot and Tanjore and the former is, I hear, used to preserve horse-grams, etc., in parts of the Kurnool District. For my own part I doubt whether these have any insecticidal value in keeping away store pests. In some villages along the Mysore uplands, such as Kollegal, grains like *ragi* (*Eleusine coracana*) are stored in underground pits and these keep quite free from pests.

I have recently come to know of a very interesting method of preserving stored products in parts of Mysore, which is by keeping a small quantity of pure mercury in the same bin, and it is said to be very effective.

Speaking of the preservation of stored grains, etc., in general, the method in which store-sheds or granaries are built in different places appears to be more or less satisfactory. The bigger granaries are often built with stone pavement, higher up the ground level, and in most cases are as insect and damp-proof as possible. I have seen this to be the case in many villages in the Circar. In the South Arcot and the adjacent districts cheap insect-proof seed bins are found to be used. These are made of earth or bamboo matting, and when properly covered and plastered with cowdung, as is usually the case, the seeds or grains remain quite healthy and more or less free from vermin.

V. Other methods.

A very curious method of driving insect pests has come to my knowledge very recently. It seems that the following method is adopted in the Adoni Taluk of Bellary District to drive blister beetles. One live beetle is caught and smeared with or dipped in a mixture made up of asafœtida, cow-dung, lemon-juice, etc., and is then let ose among the companions, and it is believed that all the

beetles are driven away from the field where this dipped beetle is liberated! This method more or less approaches the modern method of spreading infection with fungi, bacteria, etc., to drive insects.

The use of natural enemies against insect pests is, of course, still in its infancy even in many advanced countries; however, see such an idea in the practice of letting loose ducks into fields infested with swarming caterpillars or grasshoppers—a practice that is noted in parts of the Chingleput District; the results appear very encouraging.

The above are some of the various indigenous practices I have been able to note, and it is quite possible that many others exist which have escaped my notice. Therefore I must admit that this paper does not exhaust all the local practices found in different parts of the country.

BOTANICAL, PLANT DISEASES AND PEST NOTES.

Some Observations on a Local Species of Mosquito.

Extract from the Official "Gazette" of 26th March, 1921.

Sir,

I have the honour to submit herewith the report on my investigations concerning the present mosquito plague in New Amsterdam; the work was performed at the suggestion of the Honourable the Colonial Secretary.

2. A plague of mosquitoes lasting several weeks and gradually diminishing is no new phenomenon in New Amsterdam and the County of Berbice generally; a number of writers during past years have recorded the abundancy and virulency of the mosquitoes in Berbice at

certain seasons. Several popular theories exist as to the origin of these pests; one widely accepted theory is that these insects originate in the large areas of swamp lands that exist on the Corentyne Coast and are blown down wind to New Amsterdam.

3. Investigations during this visit disclosed the fact that the present mosquito plague is directly due to the activities of one particular species of mosquito.

I collected specimens and made observations at a number of points both within New Amsterdam and along the swamp land fringing the river bank. In every instance the one species predominated. I refer to the well known *Aedes taeniorhynchus*, Wied. I state "well known" as the insect has, among other localities, been recorded in New York, Louisiana, Texas, Mexico, British Honduras, Guatemala, Nicaragua, Costa Rica, Panama, Trinidad, Brazil and Suriname.

Its breeding habits and the behaviour of the adult insect are also known. The following extracts from Howard, Dyar and Knab's well known monograph on the mosquitoes of North and Central America and the West Indies, Vol. IV, Part 2, concerning this mosquito will prove of interest.

P. 670. "The larvae live in brackish or fresh water "pools near the sea. . . . . The eggs are laid in the mud "and hatch when the pools are filled, a set of larvae "appearing on each such occasion."

P. 671. "Dr. Dyar found the larvae upon the salt "marshes of Southern California, where a brood appeared "in the highest pools at each monthly high tide."

P. 671. "In Mexico and Central America Mr. Knab "frequently found the larvae in large numbers in pools of "rain water, but only within the tide water region."

P. 671. "As to the bite, that is much like that of "*sollicitans* and, like that species, *taeniorhynchus* takes "no long thought in reaching a proper spot, any exposed "place will answer and it has the same ankle-seeking "propensity that its allies have."

P. 671. "In the warmer parts of Continental "America *Aedes taeniorhynchus* is the common coast

"species and sometimes appears in enormous numbers "when conditions favour the production of a brood. It "has the same tendency to migrate as *A. sollicitans* has "and has been taken far inland. Swarms of this mos-"quito have been reported at sea, in the Gulf of Mexico, "many miles from land."

With regard to this latter point several people have informed me that they have been attacked by swarms of mosquitoes whilst on board ship lying out at sea some distance from the coast of Suriname. Probably this same species is implicated.

Local observations on the habits of this mosquito are to be found in the British Guiana Medical Journal for 1913, where the Rev. James Aiken in an article on British Guiana Mosquitoes makes the following observations.

P. 37. "The rains of May, 1912, were succeeded by "another exceptionally dry season, which broke in Berbice "on 1st December and on 12th December. I noted *Aedes* "*taeniorhynchus* in numbers which increased greatly dur-"ing the remaining days of December and early part of "January, 1913."

In the same Journal for 1908 in another paper, this observer states :—

P. 20. "*Aedes taeniorhynchus* is a blundering "creature in comparison with any of those mentioned. "During the day she does not fly high and even in shade "beneath a house will bite only on the hands as they hang "by the side and on the face only if one is stooping so "that it comes within three feet of the ground. She is "slow witted and when settled waits calmly while the "hand is lifted and the point of the finger pressed gently "but firmly on her back. At night she comes in swarm, "at times into dwellings and swells the crowd of *fatigans* "*cubensis*, and other Culices, Stegomia and Anopheles "which combine after dark to break the peace of the "lieges in the colony."

My experience with this mosquito both on this occasion and for a number of years previously has been similar to the above. It is a clumsy, greedy, fearless

insect imbued with a very earnest desire to feed either at night or in the hottest midday sun. It has a distinct preference for those exposed parts of the anatomy from the waist downward.

Last week, in the New Amsterdam Botanical Gardens, one almost waded through clouds of this insect only a few of which rose higher than the waist. With a view to discovering the breeding places of these swarms I made a close survey of the swamp lands by the banks of the Berbice River in the vicinity of New Amsterdam. Fully 80 per cent. of the crab holes, more noticeably those on the drier parts of these swamps, contained numbers of the larvae of this pest. No pupae were taken and none of the larvae were more than three-quarters grown.

I also found a few young larvae in brackish pools apparently formed by the recent rains but now rapidly drying up.

Many adult mosquitoes of this species were observed to issue from the crab holes when opened up. The fact that this insect breeds in crab holes has already been recorded from Brazil.

* I may mention that the clouds of mosquitoes which occur at eventide on the Sea Wall, Georgetown, at certain seasons are of this same species.

4. I am of the opinion that the sudden swarms of the *Aedes taeniorhynchus* which appear in Berbice are due to the fact that the eggs are deposited in the mud in the littoral swamps and—are capable of there lying dormant till a supply of water comes to hand which may be brought about by an abnormally high rainfall.

During a long period of dry weather the eggs would accumulate in immense numbers, which, given a sudden adequate supply of water, would simultaneously hatch and produce a great swarm of adult mosquitoes.

The adult mosquito "carries on" during dry seasons in crab holes or other convenient deposits of water.

The breeding place *par excellence* of this mosquito is the vast swamps to be found along the coastal regions in Berbice and in *close proximity* to New Amsterdam; it is from these areas that the swarms issue forth and descend upon the inhabited places of the County.

I have the honour to be,

Sir,

Your obedient Servant,

G. E. BODKIN,
Government Economic Biologist.

The Director,
Science and Agriculture.

COUSHI ANTS.

SOME NOTES ABOUT THEIR HABITS AND SATISFACTORY ELIMINATION.

Leaf cutting or Parasol Ants (known locally as Cooshie ants) are easily the most dangerous enemies to vegetation in these parts of Tropical America in which they occur. Their peculiar habits of cutting off fair-sized pieces of leaves of various trees which they carry back to their nests held upright in their jaws is well known to everyone who has lived in this part of the world. They march along regular tracks, one after the other, and their columns which are often of great length consist of two streams going in opposite directions to each other, the one composed of the ants laden with their booty returning to the nest and the other of ants which have deposited their pieces of leaves in the nest and are coming back for more. They have been observed to go as far as half-a-mile from their nest to attack certain trees although other trees on which they are known to prey are to be found within a

much shorter distance. Not only leaves but also pieces of flowers, fruits and seeds are taken back to their nests.

These nests, which are usually situated in a spot in the forest clear of large trees, are often of huge size measuring up to 30 feet across and even more, while underground tunnels run from them in different directions for long distances. There are always a number of openings leading into the nest.

For a long time naturalists were puzzled as to what use was made of the pieces of leaves after they were taken into the nest. By some, the ants, were believed to use them directly as food; others imagined that they used them for roofing the underground parts of the nest. In his excellent book "The Naturalist in Nicaragua" Thomas Belt, who was a mining engineer by profession, made the suggestion, which has since been verified, that the leaf-eating ants use these pieces to form beds on which they grow a certain species of mushroom which serves as food for themselves and their young.

Inside the nests these pieces of leaves are cut up very finely and kneaded with their feet and jaws forming a yellowish-brown spongy substance, in which no particles of the original leaves can be distinguished, on which the fungus is grown. This particular fungus is carefully looked after and cultivated and all other kinds of fungi, which we might call 'weeds' are prevented from growing. So carefully and intelligently is this carried out that the ants have been able to produce a new growth in the fungus, as different as many of our cultivated fruits and vegetables are from their original wild forms. In many cases it has been proved that if the ants are deprived of this special food they die of hunger.

It has been discovered that each of the female ants—large dark-brown, fat bodied creatures measuring nearly $\frac{3}{4}$ inch in length, with two pairs of large brown wings, which may be seen issuing from the nest at certain times of the year—carries in a cavity at the back of her mouth a pellet consisting of filaments of this fungus, with which she is able to establish a fresh fungus garden when she starts making a new nest.

PLANTS ATTACKED.

The Cooshie Ant shows a decided preference for certain kinds of cultivated plants such as roses, oranges, coffee, mango, avocado pear, etc. As a rule introduced plants suffer much more than the plants indigenous to the regions where the ants are found. Many of the latter have special adaptions or contrivances for keeping away leaf-cutting ants, amongst which are the provision of special dwelling-places in their stems, leaves or thorns, and also food for certain other ants of a warlike disposition which, while they cause no injury to the plant which harbours them, at the same time protect its leaves from the attacks of the Cooshie ants. Some six or seven different species of this ant are known to occur in British Guiana. The large brown species found along the Coastlands is the commonest and most destructive. Smaller species occur in the soils of the North West District and the far interior.

METHODS OF DESTRUCTION.

Since Mr. Belt's classic experiments in 1874 on the extermination of these ants which consisted in the use either of carbolic acid and water, mercuric chloride, tar, or in some cases the interment of a dead animal in the centre of the nest, innumerable experiments with a great variety of substances have been tried. Methods of elimination by mechanical means have also been tested. Belt summed up his experiments pretty accurately by remarking that if the ants were sufficiently worried they evacuated their quarters only to migrate elsewhere. None of his attempts, therefore, were entirely successful. Methods of pumping various noxious gasses down into the nest have been devised but none have ever proved anything like final in their effect.

Pumping sulphur dioxide gas into the nest I experimented with myself some 7-8 years ago but got no positive results ; I have heard that this same method was attempted on a large scale at His Majesty's Penal Settlement fully twenty years ago but proved useless.

Coushi ants and their nests can be destroyed with

certainty either by means of 'puddling' (which is a mechanical method of destruction) or by the use of carbon bisulphide.

Puddling can only be indulged in on soils of a heavy nature; it is no good on a sandy soil. Carbon bisulphide can be used on any soil.

The method of puddling is too well known to need description here. The use of carbon bisulphide is not so well known and may be described as follows:—Having satisfactorily located the nest all exist holes are carefully and thoroughly closed up with well ramed earth. Towards the centre of the nest and, according to its size, two or more of the larger exit holes are left open. Down each of these holes are poured about a couple of fluid ounces of carbon bisulphide. The holes are then closed up for several minutes. A torch is meanwhile constructed consisting of dry 'bush' tied to a long stick. The bush is then set fire to, the holes uncovered and the torch applied. The necessity of having a long stick will then become apparent for, as soon as the flames approach the hole a violent underground explosion takes place which is repeated at varying intervals as the flame of the first explosion penetrates the distant underground galleries of the ants. All the holes left exposed are thus 'touched off'.

The theory of the procedure is that carbon bisulphide which is a very highly inflammable, volatile liquid with a pungent smell on being poured into the hole quickly volatilizes and mixes with the air, this mixture very rapidly penetrates into the remotest parts of the nest and, as soon as the flame is applied, explodes with violence.

Properly handled—and such is not difficult—this method of destroying coushi ants is perfectly successful and the largest nest can be eliminated with certainty, ease and simplicity. No expensive machinery is necessary and any individual possessed of ordinary intelligence can satisfactorily perform the operation with but little or no practice.

G. E. BODKIN,
Government Economic Biologist.

Bamboos.

Most of the bamboos of America belong to genera peculiar to the New World, *Guadua* taking the place of *Bambusa*. *Chusquea* that of *Schizostachyum*, etc., only *Arundinaria* and *Nastus*, perhaps, being indigenous to both hemispheres, although some Asiatic species have become naturalized in the West Indies. The reed-bamboos (*Arundinaria macrosperma* and *A. tecta*) which are of no great height, from the low-lying extra-tropical 'cane-breaks' which characterize the most northern extension of the group on the Continent, the first-named occurring in Florida and on the shores of the Mississippi and in Arkansas, whilst the second is found in Kentucky and near Philadelphia. Forty years ago a considerable quantity of paper-pulp was annually made from *A. macrosperma* in North and South Carolina, and the lowlands of the Mississippi. The cane was cut into pieces, tightly packed in cast-iron cylinders, 22 feet long and 1 foot in diameter, known as 'guns,' fitted with very strong steam-domes. After fifteen minutes treatment with steam at 180lbs. pressure, the cane was shot out of the gun against an iron sheet by the sudden opening of one end of the cylinder, and thoroughly disintegrated by the expansion of the compressed absorbed steam. The utilization of this species by modern methods is now under consideration in Louisiana.

Most of the taller species of the small related genus, *Arthrostylidium* occur at high altitudes. The slender *Arthrostylidium racemiflorum*, for instance, grows at 6,500 to 7,500 feet in Mexico, and the taller and stouter *A. Schomburgkii*, the long, basal joints of which—the longest of known bamboos—are used for the native blow-tube or 'sarbican' occurs at 6,000 feet in Guiana, and in the mountains near the sources of the Orinoco and Rio Negro. *Chusquea aristata* occurs in the same region, in dense thickets, at 13,000 to 15,000 feet. *Guadua angustifolia*, which grows to 30 or 36 feet in height, and to 6 inches in diameter, is described by Humboldt as 'forming forests several leagues in extent, in hot valleys and at

moderate elevations' (about 2,400 feet) in Ecuador and Colombia, but the species of this genus probably more often occur in comparatively small thickets.

A considerable portion of the area occupied by gregarious bamboos in Trinidad is made up of introduced Asiatic species, especially *Bambusa latifolia*, though the nearly allied Venezuelan species, *Guadua latifolia*, also occurs; and, at high altitudes the large *Arthrostylidium excelsum*, and *A. pubescens* are found. Paper has for some years been made in Trinidad more or less completely from bamboo pulp, and Messrs. Nelson, of Edinburgh, have a concession for cutting bamboo in the Government forests, and have planted 1,000 acres near St Joseph, 7 miles from Port-of-Spain.

Though bamboos occur generally throughout Jamaica, they do not occupy extensive continuous areas; and although under present conditions they might be remuneratively cultivated, a London newspaper, which some years ago took for a time a considerable quantity for paper making, abandoned the enterprise because the supply was inadequate. So, too, in British Guiana, though several useful species occur sporadically, and there would be little difficulty in cultivating them, they do not appear at present to occupy any large continuous areas.—*Bulletin of the Imperial Institute, 1920.*

EXPORTS OF AGRICULTURAL AND FOREST PRODUCTS.

Below will be found a list of the Agricultural and Forest Products of the Colony exported during the first six months of 1921. The corresponding figures for the two previous and the average for the four years previous to that are added for convenience of comparison.

Product.	*Average 1915-18.*	*1919.*	*1920.*	*1921.*
Sugar, tons ...	41,873	37,167	36,329	34,251
Rum, gallons	1,948,345	3,036,093	1,011,761	1,582,575
Molasses, gallons	2,167	171,247	None	None
Cattle-food, (Molascuit) tons	912	818	552	1,055
Cacao, cwts. ...	91	None	8	None
Citrate of Lime, cwts.	116	83	229	34
Lime Juice, gals.	3,078	7,551	—	441
Essential Oil of Limes, gals.	117	136	—	108
Coconuts, thousands	926	2,328	2,218	1,456
Copra, cwts. ...	988	864	296	599
Coffee, cwts. ...	1,579	7,128	2,989	390
Kola-nuts, cwts. ...	2	None	10	None
Rice, tons ...	7,622	1,288	8,036	4
Ricemeal, tons ...	86	None	None	None
Cattle, head ...	352	1	—	None
Hides, No. ...	1,471	3,769	3,405	1,832
Pigs, No. ...	402	None	None	None
Sheep, head ...	11	None	136	None
Balata, cwts. ...	4,628	2,262	2,167	3,469
Charcoal, bags ...	24,205	22,764	24,785	23,268
Firewood, Wallaba, etc., tons ...	4,833	4,339	2,708	3,491
Gums, lbs. ...	248	315	3,361	7,913
Lumber, cub. ft. ...	88,374	84,311	130,330	49,315
Railway sleepers, No.	3,698	1,508	4,707	3,114
Rubber, cwts. ...	34	51	118	6
Shingles, thousands	1,170	1,336	883	1,012
Timber, cub. ft. ...	38,913	38,825	29,587	83,097
Coconut Oil, gals....	13,532	4,451	24,971	7,705

ERRATUM.

Vol. XIV. No. 2. April, 1921. Page 141.

"Exports of Agricultural and Forest Products"—Sugar export for first quarter, 1921, should read 15,864 tons.

ATTENDANCES AT THE DISTRICT GARDENS

Year.	Bourda.	Belfield, E. Coast.	Stanley, New Amsterdam.	Suddie, Essequibo.	Den Amstel.	Houston, E. Bank.	Wakenaam.	Total Attendances
1912 ...	5,514	4,395	3,302	2,100	2,544	2,156	718	21,729
1913 ...	5,156	4,535	2,519	3,399	2,568	1,836	1,319	21,332
1914 ...	4,243	3,869	2,443	3,025	1,791	1,653	1,533	18,577
1915 ...	1,123	1,006	769	59	503	339	401	4,200
1916 ...	4,705	1,161	1,510	225	623	2,251	1,297	12,026
1917 ...	4,991	2,820	1,366	3,297	1,186	2,564	1,663	17,886
1918 ...	4,834	3,081	1,653	2,671	2,162	2,790	2,067	19,258
1919 ...	4,769	2,425	1,582	2,798	1,851	2,480	1,556	17,461
1920 ...	6,285	2,312	1,665	2,525	2,532	3,228	2,148	20,695
1921 ...								
1st Quarter	1,761	639	502	307	673	829	490	5,201
2nd Quarter	1,790	554	410	1,408	549	812	430	5,953

Meteorological Data—April to June, 1921.

Months	Rain-fall.	NUMBER OF DAYS OF RAIN						Evapo-ration.	Air Temperature and Humidity.			
									Air Temp.			Humidity,
	Total Inches.	Under ·10 Inches	·10 to ·50 Inches	·50 to 1.00 Inches.	1.00 to 2.00 Inches	Above 2.00 Inches	Total days	Inches	Max imum	Minimum	Mean	Mean
Botanic Gardens.												
April ...	8.56	8	8	4	...	1	21	4.65	84.7	76.0	80.3	79.1
May ...	1.20	5	3	...	...	...	8	6.60	85.0	78.4	81.7	72.1
June ...	21.15	4	14	5	3	3	29	2.90	84.6	74.6	79.6	82.9
Totals & Means.	30.91	17	25	9	3	4	58	14.15	84.7	76.3	80.5	78.0
Onder-neeming.												
April ...	8.56	5	6	3	3	...	17	...	87.4	72.6	80.0	...
May ...	2.09	3	7	...	...	...	10	...	88.1	72.7	80.3	...
June ...	11.52	2	14	5	3	...	24	...	88.1	72.7	80.4	...
Totals & Means.	22.17	10	27	8	6	...	51	...	87.8	72.3	80 2	...
Berbice Gardens.												
April ...	11.35	1	7	5	1	2	16	...	83.4	74.8	79.1	75.7
May ...	2.52	...	2	1	1	...	04	...	82.7	75.0	78.8	88.2
June ...	15.37	3	18	5	4	...	30	...	81.9	75.2	78.5	73.3
Totals & Means.	29.24	4	27	11	6	2	50	...	82.6	75.0	78.8	79.1
Mora-whanna												
April ...	16.13	2	10	1	2	3	18	...	...	...	...	...
May ...	8.75	3	11	-	1	...	17	...	...	...	...	...
June ...	22.74	4	10		5	2	30	...	...	...	...	...
Totals ...	47.62	9	31	12	8	5	65	...	...	...	...	...

ERRATA.

PAGE 220. For table read as under.—

	Total.	Available to 1% Citric acid.
Water .. , .	3 50	
Loss on ignition (chiefly organic matter*)	8.12	
Sand and insoluble	73.58	
Iron oxide	4.51	
Alumina	8.98	
Lime	·20	
Magnesia ..	·50	
Potash ..	·21	.020
Soda	·20	
Sulphuric acid	·08	
Phosphoric acid	·09	.010
Carbonic acid	nil	
Hydrochloric acid	·03	
	100.000	

*Containing Nitrogen. .25

PAGE 276. Ninth line from top for 'during' read 'owing to.'
In table 'Results of the Agricultural Census for 1919 and 1920.'
Acres under Sugar Cane 1920 for 59,532 read 69,532.

PAGE 277. For 'Bags of 140 lbs Padi' read 'Bags of 140 lbs. Padi per acre.

PAGE 278. Third line from bottom for 'County of Berbice' read 'County of Demerara.'

PAGE 279. Fifteenth line from bottom delete words 'cattle and'
Eighteenth line for 'cattle' read 'horses'

PAGE 294. For Meteorological Data—Suddie read -

Suddie.												
J[illegible] ...	11.05	1	7	6	4	..	18		87 9	72 8	80 3	
[illegible]gust ...	6 10	5	2	3	2	..	12		87.8	72 7	80 2	
September ...	4.15	2	8	1	1	..	12		87.8	72.7	80.2	
Totals & Means	21·30	8	17	10	7	..	42		87·8	72.7	80.2	

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AGRICULTURE AND MALARIA.

THE various advantages and disadvantages which are encountered in agricultural practices in British Guiana are familiar to most of us. Problems of labour, vagaries of the rainfall, pests and prices, all, from time to time, receive a full share of discussion and give rise to much speculation as to what lies in store.

There is, however, an aspect which by no means receives that share of attention to which it is fully justified—we refer to the adverse and far-reaching effects of Malaria on practically every form and phase of agricultural activity in this colony.

Statistics are apt to become a trifle irksome, but it is certain that if figures were prepared to illustrate the actual annual financial losses to the principal agricultural industries of British Guiana, owing to the effects of this insidious disease, they would prove more than astonishing.

An interesting feature in this connection is that alluded to in an article * reproduced in this issue whereby malarial swamp lands may not only be eliminated but be gradually transformed into areas of agricultural value.

We commend a perusal of this article to our readers.

* Agriculture *v.* Malaria.

CHEMICAL ANALYSIS OF SOILS: ITS VALUE AND LIMITATIONS.

By Jas. Crabtree, M.Sc., F.I.C.

During the past decade an appreciable alteration has been manifested in the attitude of the practical man towards the scientist in nearly every industry, a change impelled chiefly by the increasing intricacies of most industrial processes, occasioned by their developments, and one which is likely to progress with further advances. Formerly misunderstood, and regarded as an abstruse dreamer, the scientist is coming to be regarded in his true light; "science" means "knowledge" and the scientist is a knowledge specialist, an individual whose function is the acquisition of information of the fundamental laws of nature which are the basis of every change or process, and the application of such information to the improvement of such processes and changes as are necessary to the most economical production of those materials on which man is dependent for his welfare and comfort.

In the swing of the pendulum away from distrust of the scientist there is a tendency, perhaps unavoidable, of going too far in the other direction, and expecting too much from this worker. Too often is he regarded in the light of a kind of wizard possessed of mystic powers and store of knowledge, an impression which it is to be feared, is in some cases not violently discouraged by the individual himself. He is, however, but human, and probably encounters more insoluble problems than most of his brothers in other walks of life; a closer comprehension by the latter of the limitations of the knowledge at his disposal, and the difficulties which beset his way, cannot but lead to a greater appreciation of the results he obtains.

In indeavouring to arrive at some conception of the value and possibilities of the work of the scientist, it should be remembered, that for thousands of years, man has been acquiring information by the slow and

laborious method of "trial and error" and applying this information to his methods by the process of the "rule of thumb". Astonishing as has been the advance from this position within the past century, it must be obvious that the comparatively short study of modern times cannot possibly be expected to have thoroughly elucidated, considerations of modern developments apart, even the phenomena observed, and methods developed, during those thousands of years. In no branch of study is this more apparent than in Agriculture, the most ancient of the arts, and the most complex of the sciences. In no science has so much been learnt in a short time, or so little relative progress been made in comparison with the information acquired. This is not surprising, when we reflect that in the growth of any plant are involved considerations of plant physiology and heredity, physical conditions (soil texture, temperature, water, air and light supply), chemical problems of soil reaction and plant food (themselves involving questions of bacteriological, protozoological, and fungal changes), with extraneous modifications occasioned by diseases and pests of the plant. Difficult as is the study of any single one of these aspects, the correlation of all of them essential to the full consideration of any Agricultural problem, must be still more so, especially as the undue or insufficient stressing of any one aspect may profoundly modify the conclusions to be arrived at. The information to be obtained by the study of any one only of the above mentioned aspects is limited, and it is the limitations of the ordinary routine chemical examination (or analysis) of soil, that it is intended to discuss in this article.

By "soil" is generally understood any exposed portion of the earth's surface which will support the growth of the higher plants. It consists essentially of two classes of materials, disintegrated rock, and "organic matter" or plant and animal debris: variations in extent of disintegration of the former, and the chemical changes it has undergone, and in the

amount of modification of the latter, determine the resulting type of soil, which, as is well known, may vary within very wide limits. Nevertheless, the essential components are the same in all cases, and it is their relative proportions, climatic conditions apart, which determine the extent of the ability of the soil to support plant growth. It is with the determination of the said relative proportion that chemical analysis is concerned.

The chief components which influence plant growth in any way, and with which the analyst chiefly concerns himself are :—"Organic matter" (containing essentially nitrogen, carbon, hydrogen, and oxygen). Sand, (and other matters insoluble in strong acids) Iron, Alumina Lime, Magnesia, Potash, Soda, Sulphates, Carbonates Phosphates, Chlorides (sometimes).

The results of a typical so-called "complete" analysis of cane soils of this colony are set out below, as an example

	Total	Available to 1% Citric acid.
Water	3.50	
Loss on ignition (chiefly organic matter*)	8.12	
Sand and insoluble	73.58	
Iron oxide	4.51	
Alumina	8.98	
Lime	.20	
Magnesia	.50	
Potash	.21	
Soda	.20	.020
Sulphuric acid	.08	
Phosphoric acid	.09	.010
Carbonic acid	nil	
Hydrochloric acid	.03	
	100.00	

* Containing Nitrogen .25

Of these substances, the materials directly essential to plant growth are the nitrogen, potash, phosphoric acid, lime, magnesia, iron and sulphuric acid, though the cases where the soil does not contain a sufficiency of lime, magnesia, iron or sulphuric acid for the requirements of any crop being rare, the first three ingredients may be regarded as the real essentials. All others are of indirect interest only; their respective rôles are often more or less imperfectly understood, though often of predominant importance; a consideration of them is outside the scope of this article.

Now an inspection of the above soil (or preferably a "mechanical analysis" showing the relative proportions of particles of different diameter) will have shown the analyst that the soil is a fairly heavy clay, and from his previous experience of such soils, he is able to say from the chemical results above that this is a soil of distinct potential fertility (*i.e.* it can produce substantial crops of various cultivated plants for a considerable period, given reasonable husbandry and climatic conditions). He might be a little doubtful about the lime content especially as it is less in amount than the magnesia; he might also reasonably doubt the ability of the phosphoric acid to hold out over a long period; a determination of the so-called "available" proportion of these substances mentioned below would help in some respects, but unless the analyst had already had information of the behaviour of that particular class of soil under the conditions and crops under which it was proposed to work it, he could not with confidence state that such and such was the best method of treatment, or of manuring.

Now suppose a crop of say sugar cane is grown on this particular plot of land, and assume that the roots of the cane feed on only the upper 18 inches of soil; assume also that an acre of this soil to that depth weighs 3,000,000 lbs.; there will then be present in this amount of soil 7,500 lbs. of nitrogen, 6,300 lbs. of potash, and 2,700 lbs. of phosphoric acid by the above analysis. (Even this does not represent the whole as there is still present some potash at any rate in the "insoluble" portion.) The amounts "available" to citric acid will be, potash, 200 lbs., phosphoric acid

100 lbs. Now, if in cultivation a crop of cane were obtained of, say, 40 tons per acre, it would, according to analyses by Stubbs in Louisiana, remove in the whole crop, canes and leaves, about 40 lbs. of nitrogen, 90 lbs. of potash and 60 lbs. of phosphoric acid, that is between 1 and 2 per cent. of the total amount and 60 per cent. of the "citric acid available". On the face of it this would seem to the lay mind to indicate that there was no need to apply any manure of any kind to obtain a crop of this magnitude; yet we know from experience, that in actual cultivation, this soil would, if left unmanured, probably not give us more than about 10 tons. The explanation of this is, that the plant is not able to use the major portion of the material the analysis records as being present; only a quite small proportion of the plant food in any soil is in a condition to be directly used by the plant, and it is largely on the rate at which the stored-up materials become available that the productivity of the soil depends. The difficulty of ascertaining this rate will be realised when one notes that the analyst obtains his amounts of plant food from the soil by dissolving it out with concentrated acids, usually at high temperatures; moreover, his results will vary according to the strength of the acid he employs, the temperature he uses, and the duration of time over which the acid is allowed to act on the soil. Now the plant has neither strong acid, nor high temperature, at its disposal, and moreover takes months in abstracting from the soil the materials it requires. It does not require much reflection to appreciate that there will be substantial discrepancies between the analysis made by the analyst and that made by the plant. Herein lies the difficulty of the whole matter. The exact manner in which the plant dissolves out the mineral ingredients at any rate, is not as yet thoroughly understood, and the difficulty of simulating, in the short time at the analyst's disposal (hours or days) what the plant effects slowly over a long period, has so far proved insurmountable. Many attempts have been made to do this, the most successful of which was by Dyer, who, in 1894, estimated the acidity of the roots of a large number of plants, and finding it to be on the average

about equal to a one per cent. solution of citric acid, used this latter solution to digest soils for a considerable number of hours: the amounts of mineral constituents he extracted in this way he considered as immediately available to the plant, and found that his results were borne out by the cropping figures of the soils of the Rothamsted and other experiment stations. The method seemed at first sight simple and alluring, but it has since been found that the acidity of the root sap has very little to do with the solution of the mineral ingredients, and that far from being simple the reactions involved are hedged around with numerous complications, a consideration of which would be out of place here. Nevertheless the method has proved to be of considerable value when used in connection with manurial plots and is practically in world-wide use. Other investigators have used different solvents such as dilute hydrochloric and nitric acids, aspartic acid, ammonium citrate, and so on, but to no particular advantage. Even in this method, however, it is impossible to draw general conclusions, for different crops require different amounts of mineral ingredients, and different soil reactions, and inferences drawn from one crop would probably fail with another.

About 1890 several German investigators, losing faith in the abilities of chemical analysis to give information as to manurial requirements, instituted the method of "pot culture" in which crops under inquiry are grown for longer or shorter periods in pots containing the particular soil about which information is required, using different methods of manuring: in short a condensed series of manurial trials. The method, however, proved too cumbersome and was not directly applicable to field conditions, and though of great value in studying soil problems, pot culture is not now used in the routine of soil "analysis."

The question the practical man requires an answer to, from the analyst, is, "what manuring does my soil require *now* to give me the best results at the least cost"? and it is, with this in mind that the subject is being discussed here, for after all, that is all the majority of practical men are interested in. With analytical methods only at one's

disposal a definite answer cannot be given to this query. The only really reliable information is that obtained from actual field trials on the particular class of soil under inquiry in which varying amounts of different manures are applied and their results on crop production accurately recorded from year to year. It is in connection with these field trials that analysis is of the greatest value in the light of the question we are considering. When definite results have been obtained from field trials on the broad general types of soil in any given country or district, and analyses have been made of the soils of the plots from time to time, then definite advice can be given on the handling of any particular field elsewhere by sampling the soil on it, comparing its analysis with that of the manurial plots about which we have accumulated so much information, and by means of this comparison, advising in the light of the results obtained on the particular type of soil in the field experiments. In the most progressive countries the agricultural districts are being mapped off by "soil surveys" into areas of the different soil types, classified according to the results of chemical and mechanical analysis, and experiment stations established on those types of sufficiently large area to warrant it. The correlation of any particular field with the fields of the plot trials is then established by analysis, and the advisor thus placed in a really sound position to advise on treatment. The matter is not of course as simple as this statement might make it appear: it is the *principle* only that an attempt here is being made to explain.

Cases of pronounced infertility are a much simpler matter and here the ordinary chemical analysis is on much safer ground: these cases usually result from the marked absence of some plant food, or from some pronounced reaction of the soil, or presence of an injurious factor. These can almost always be traced.

It would be as well to point out here that information obtained from plot trials may not be indispensable where an analyst has been working for some years with soils of one or two different types and has been at the same time

able to follow up the performances of these soils in the field. Here his long experience will serve him : he has in fact been accumulating during those years of experience precisely that information which the plot trial is designed to give in greater detail. Unfortunately, however, this experience is often of a nature that cannot be recorded in terms of words and figures, while the statistics of the experiment station plots are at all times available to others.

To recapitulate then :—

Chemical analyses of soils alone, can, in the present state of our knowledge, tell us whether a soil is, or is not, fertile : i e., capable, with reasonably good husbandry and climatic conditions, of supporting crops of plants of value to man, for an indefinite period. This information is ordinarily of value only to an agriculturist taking in virgin andor entering on operations in cultivated lands of which he has no previous experience.

It can usually elucidate cases of pronounced infertility in apparently fertile lands.

Its greatest value directly to the everyday operations of the practical man is usually in conjunction with field trials, for in this way only can really reliable information be given about such problems as manuring and general cultivation.

SOME RECENT ENTOMOLOGICAL SURVEYS BEARING ON MALARIAL INCIDENCE IN BRITISH GUIANA.

By G. E. Bodkin, B.A. Dipl. Agric. (Cantab), F.E.S.
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(A paper Read before the West Indian Medical Conference held in B. Guiana, July, 1921.)

The Biological Division of the Department of Science and Agriculture since its inception in 1911 has, from time to time, made studies of the various species of the malarial transmitting mosquitoes of British Guiana, their habits and breeding places.

Recently, on the suggestion of the Surgeon General and the Director of Science and Agriculture, mosquito surveys of a number of sugar estates and other areas in different parts of the Colony have been made with special reference to the breeding places of Anopheline mosquitoes.

The technique employed is based on experience gained locally, and from practices evolved by other investigators in different parts of the world.

In making an examination of a sugar estate, for instance, a plan of the residential areas of the estate showing also the various irrigation, drainage and water navigation schemes is, if possible, obtained.

All these various areas of water are then carefully examined for mosquito larvae by the well known "dipping" method.

For dipping a white enamelled soup ladle of medium size is utilized. Samples of the water to be examined can by this means be conveniently secured and the white background renders the observation of any larvae or pupae that may be present an easy matter.

Frequent samplings of the water among grass, other vegetation and many places which experience has shown to

be probable lurking places for mosquito larvae will give an accurate idea as to the number and species of larvae present.

In making an examination of a part of any particular piece of water never less than twenty-five to thirty dippings are made. If no larvae are then obtained the results are marked negative.

Any larvae or pupae obtained are transferred to glass tubes loosely plugged with cotton wool.

Development is allowed to proceed and the adult mosquito eventually secured. Field notes are made on the spot. The identification of the adult mosquito is made in the British Museum through the Imperial Bureau of Entomology.

A plan of the Estate is finally made indicating the various breeding places of mosquitoes, with particular reference to Anopheline areas.

With regard to the breeding places of Anopheline mosquitoes on sugar estates and the species concerned some interesting results have been secured.

So far only one species of Anopheline mosquito has been taken; it is the well known *Anopheles tarsimaculata.* Goeldi. Indeed, this appears to be the prevalent species of Anopheles throughout the coast lands of British Guiana.

Its breeding places are invariably shallow, grass-grown drains well shaded from the direct rays of the sun. I have never found the larvae in any except comparatively clear, fresh water.

At Pln. Blairmont in Berbice, where the first mosquito survey was performed, numbers of the larvae of this particular Anopheline were taken in the small drains in the cane pieces surrounding, and in close proximity to the residental areas of the estate. The canes had attained a height of eight to nine feet and consequently ample shade was provided. The drains were grass grown and contained almost clear water.

A most dangerous association was thus brought to light—to wit—a fruitful source of Anopheles mosquitoes within a hundred yards of the manager's house, the

overseers' quarters, the estate's hospital and the dwelling ranges of the estate's work-people.

This survey was executed during dry weather, in the wet weather the breeding facilities of this mosquito would be greatly widened.

Similar associations were revealed during the examination of other estates. In one instance a large ornamental and vegetable garden attached to the manager's house was found to contain a number of active Anopheline breeding places in the shape of small grass-grown drains and in some larger drains partially obscured with vegetation.

In another instance the small drains in a sugar cane seedling plot were similarly implicated.

On every estate so far examined Anopheline breeding areas have been detected in close proximity to the inhabited portions An examination of the various estates, hospitals malarial statistics bear witness to the result of such associations.

The Potaro District in British Guiana, some three days' travel from the coast lands, has for many years borne an unenviable reputation for a particularly malignant form of malaria.

Early this year I was deputed to make a mosquito survey of the district and some interesting points were brought to light.

From my pretty wide experience of the forest area of this country I can positively state that it is an exceedingly rare event to encounter an Anopheles mosquito within such areas.

Prior to my Potaro survey* I had previously, in one place within the forest only, known Anopheles mosquito to occur. I allude to Rockstone, the terminus of the Wismar—Rockstone railway. During almost every visit that I have made to this place, I have both observed and been bitten by Anopheles mosquitoes. I may add that this place has, in the past, possessed a sinister reputation for malaria.

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*Report on malarial mosquitoes in the Potaro District printed in this number of the Journal under "Plant Diseases and Pest Notes."—G.E.B.

I was, therefore, much surprised to find Anopheles mosquitoes to be common in certain parts of the Potaro District. At the so-called 10 miles it was the common species. Specimens submitted to the Director of the Imperial Bureau of Entomology have been identified as *Anopheles agryritarsis*, R.D. I did not secure a single specimen of *Anopheles tarsimaculata*, Goeldi. in this district.

Larvae were discovered in old tins covered with vegetation and containing water kept fresh by rain drips from the surrounding vegetation. The annual Potaro rainfall consists of some 150 inches.

This district is one of empty tins, flasks and bottles due to its distance from civilized centres, and the necessity of carrying food and beverages in such receptacles. So the Anopheline and other species of mosquitoes are ever well provided with suitable breeding places.

Another dangerous association was brought to light here and this was the presence of a clear, grass-grown stream containing many Anopheline larvae in close proximity to the local hospital.

MEMORANDUM ON THE FALLING OFF IN THE NUMBER OF CATTLE SINCE THE YEAR 1916.

1. The returns of the numbers of cattle on the Coastlands of the Colony as shown by the yearly Agricultural Census during each of the years from 1912, a year of intense drought which resulted in a very great diminution of the cattle in the Colony especially of those of the County of Berbice, have been carefully revised by the Director of Science and Agriculture and are as follows:—

YEARS.	CATTLE, HEAD.
1912	66,000
1913	75,240
1914	79,500
1915	87,760
1916	93,264
1917	86,663
1918	77,108
1919	79,614
1920	85,936

Experience has proved that such returns as the above are subject to error in excess or in deficit of approximately 8% to 10% in each year. Making such an allowance the figures indicate a steady increase in the number of cattle in the Colony from the year 1912 to 1916. A marked falling off in the years 1917 and 1918 and a gradual increase from the latter year to the present time.

2. It is a somewhat difficult matter to compare these records with those of other places but published records of the United States and of Canada covering 40 years during which the number of cattle under report increased from 22,700,000 to 80,545,900 may be used for this purpose. If the cattle on the Coast-lands of British Guiana had increased at the same rate as those in the North of America did the following would have resulted.

YEAR.	NO. OF CATTLE BY CENSUS.	NO. OF CATTLE ESTIMATED.
1912	66,000	66,000
1913	75,240	70,158
1914	79,500	74,578
1915	87,760	79,276
1916	93,264	85,290
1918	77,103	95,222
1919	79,614	101,221
1920	83,938	107,397

3. It is evident from the above that the rates of increase indicated by the Census returns from 1912-1916 were considerably higher than those of the North American Countries. If the cattle on the Coast-lands had continued to increase from 1912 to 1920 at the average rate they did from 1912 to the end of 1916, the number of head at the end of 1920 would have been in round figures 137,760. The cattle on the Coast-lands are now in round figures 51,800 less than they should have been if the 1912-1916 rate of increase had continued and 23,460 less than if they had increased at the Northern rate. Even if the 77,108 head of cattle returned as present on the Coast-lands in 1918 had increased at the 1912-1916 rate to the end of 1920 they would have been at December 31st, 1920, 93,300 or say some 9,300 more than were returned at that date.

4. Without doubt this depression in the rate of increase in the herds of cattle is due to several causes some of which are beyond our control but an important one which should be controlled is the indiscriminate slaughter of milch cows and promising young heifers. The following records have been obtained by the Government Veterinary Surgeon and the Director.

RETURNS OF SLAUGHTERINGS AT THE ABATTOIRS AND BUTCHERIES FOR THE YEAR 1919.

	GEORGETOWN ABATTOIR.	NEW AMSTERDAM ABATTOIR.	COUNTRY BUTCHERIES.
Bulls, oxen and steers.......	4,199	536	2,092
Cows	1,857	189	783
Heifers	567	79	383

Returns of Slaughterings at the Abattoirs and Butcheries for the year 1920.

Bulls, Oxen and Steers	4,796	658	2,488
Cows	1,849	291	1,046
Heifers	373	62	384

The totals are as follows:—

	1919	1920	1919 & 1920
Bulls, oxen and steers	6,827	7,942	14,769
Cows.	2,820	3,186	6,006
Heifers	1,029	819	1,848

5. The records of the Georgetown Meat Inspector show that of 2,050 cows slaughtered 77 were of promise as future milchers, whilst of 790 heifers slaughtered 200 showed promise of becoming good milch cows. These figures are equal to 3.7 and 32.4% respectively. It may be safely assumed that of the 3,000 cows slaughtered annually 110 were potentially good milchers, whilst of the 924 heifers slaughtered at least 300 would, if not killed, have become good milch cattle. In round figures at least 400 Milch cattle are thus lost to the Colony each year. The slaughter of the heifers and young cows, each of which might have become the parent of say three heifers, results in actual and potential loss to the cattle industry of 1,600 milch cattle per annum.

There are not any figures available indicating how many productive Milch Cattle are among the cows slaughtered but it appears probable that the great majority of the cows slaughtered are sterile either from age or from physical defects.

6. Neither export, the extension of the Rice industry, nor any disease of the cattle can account for their lessened rate of increase during recent years and hence control over the slaughter of cows and heifers appears desirable. Such control is strongly supported by the following statement from the records of the Georgetown Abattoir.

Proportion of cows and heifers to total cattle slaughtered from the year 1914 to the year 1920.

YEAR.	PER CENT.
1914	16·1
1915	19·6
1916	20·4
1917	26·3
1918	44·1
1919	36·4
1920	27·6
1921 1st Quarter	33·1
1921 2nd Quarter	32·1
July	43·3

The Stabroek Butchery Co., Ltd., in a letter to the Government has represented that in its recent slaughtering the proportion of female to male cattle has been 60 per cent.

7. The proportion, 36.1 per cent. of cows and heifers among the cattle slaughtered in New Amsterdam and in the country districts during the years 1919 and 1920 has been higher than the average rate during the same period, 32 per cent., in the Georgetown Abattoir as is shown by the following :

1919	Cattle Slaughtered.	Cows and Heifers Slaughtered.	Proportion of Cows and Heifers to cattle slaughtered (per cent.)
New Amsterdam	795	259	32.5
Country Districts	3258	1186	36.4
1920			
New Amsterdam	1011	353	34.9
Country Districts	3918	1450	77.0
Total ...	8982	3248	36.1

J. B. HARRISON.

AGRICULTURAL NOTES.

Selection of Seed—Coconuts—Nurseries.

On a Coconut Plantation two things are essentially necessary, i.e. the Selection of nuts for seeds and the proper maintenance of the Nurseries. Only such nuts that are quite ripe and that have naturally dropped from the trees should be chosen. Picked nuts are never completely mature and should be rejected.

The Planter who has the advantage of selecting the dropped nuts at the foot of the tree, should choose the following :—

1.—Nuts, having as nearly as possible a spheroidal shape with a slight depression at the base. These nuts vary from 8 to 9 inches in length and 7 to 7½ inches in width and 24 inches in the larger circumference. When husked they are also spheroidical in form and very big in size, divided lengthwise they are 5½ inches long and 4½ inches wide, the meat (albumen) is ¾ to ⅞ ins. thick— these are the nuts which obtain the highest market rate in the United States.

2.—Oblong shaped coconuts with a swelting towards the centre—they are generally 9 to 10 inches long and 7 to 8 inches in width. When husked, they present an elliptic form 5ins. by 6 ins.

The choice of the above shaped nuts is easy when it can be done on the estate, but when seed nuts are bought and all sorts are to be selected from, care should be taken to husk some of the coconuts, examine their form and their meat and give the preference to the round-shaped and well formed ones. Choose those with a thin "coir," unless the manufacture of coconut fibre is intended. When selecting nuts for seeds, it is best to pick out those that have dropped from vigorous and healthy trees, about 20 years old and are heavy bearers and yield fruits of good quality.

As a general rule, only heavy nuts, indicating that they contain water should be chosen ; this is easily disclosed by shaking.

As a last advice, reject such nuts which show round the "point of attachment" a bronze or black colour which differs from the colour of the nut itself and which indicates traces of mildew. These nuts are certainly unsound and have been picked before they were ripe. Always chose nuts of a uniform colour, regular in shape and having a smooth skin (epidermis).

NURSERIES.—After the careful selection of the seed-nuts has been made, a proper site for the nursery should be marked out. A uniform and level piece of fertile land—a sandy loam preferred—should be prepared and should be large enough for the number of coconuts it is intended to plant.

This site should be as near as possible to the main buildings of the estate, so that it can be easily attended to and kept quite free of weeds at all times.

6 to 8 drills parallel and near to one another should be opened in proportion to the number of nuts to be sown. On either side of those 8 drills a small interval should be provided in the centre of which a canal will be dug to bring in water and facilitate the watering of the young plants.

The coconuts are to be planted in the drills two or three inches apart and buried to the level of the stem-end and no more—they must be covered with some grass or straw, to protect them from sun and ensure a regular germination.

Coconuts should be planted vertically, this will cause the trees to grow quite straight and they will be less liable to be affected by the action of the wind. It is a mistake to plant coconuts in the same manner that they drop from the tree, because the seed bud pierces the husk horizontally and once it has burst out, it rises vertically

and this compels the young shoot to take a curve-like inclination and when the tree has attained the height of 20 or 25 feet, it will bear the effect of the wind with difficulty and will be exposed to be easily uprooted.

When or at what time should Nurseries be made? There appears to be no special time for doing this but it is preferable to start them shortly before the wet season sets in, because at that period, vegetation, which had lost some of its vigour after the great heat of the dry season begins to regain its strength and the nuts will germinate under good conditions to benefit by the advent of the first rain.

It is a very common belief in some quarters, that coconuts planted during the three days preceding or the three days following the New Moon, grow more healthy trees and it is even claimed that such trees live much longer. The conclusions arrived at as to the correctness of this assertion are yet vague and undetermined.

From the time it falls from the tree when it is considered to be fully matured, a coconut requires 12 to 15 weeks to germinate. If it happens that the germination period extends much beyond that time, this indicates that the seed-nut was not quite ripe and the seedling will not become a good and healthy tree.

Shade is not always required when establishing Nurseries. In the sandy soils of the Colony where moving water is met at two or three feet below the surface it is not needed—in fact, too much shade under those conditions will cause the seedlings to grow slender and they will not resist the wind. In stiff soils, liable to suffer from drought, shade would be advantageous and could be supplemented with banana plants. As a rule the shade resulting from the coconut themselves is generally sufficient for the needs of the young plants. Sight must not be lost of the fact that the action of the sun's rays is beneficial to coconuts.

Coconut Nurseries should be protected from the wind. If the site is much exposed to wind, a wind belt would become necessary. The "Wild Coffee" or "Cashew Nut" form good wind belts.

TRANSPLANTING.—After remaining in the Nurseries 12 months, the young seedlings can be transplanted, they will then be 2 or 3 feet high. They must be removed with a spade and all the rootlets that have burst out and are protruding from the husk must be cut with a very sharp instrument. When thus prepared, they can be carted or carried to the spot where they are to be planted without risk of injuring them.

The field to be planted should be properly cleaned or weeded and carefully lined. Stout stakes 3 to 4 feet long pointed at one end should be driven 3 or 4 inches in the ground with a mallet, at a distance of 25 feet apart. The lining must be symmetrically carried out, so as to obtain straight and long rows. Once this is done, the field is ready to receive the young plants.

A hole is dug near the stake, deep enough to allow the nut to be planted to such a depth that the top of the husk just projects above the level of the soil. If the seed-nut was completely buried, it would be exposed to the ravages of such insects like the "rhinoceros beetle" which would enter through the eye, at the point of attachment, and cause serious damages to the seedlings or destroy them.

For more reasons than one, 25 feet apart would seem tobe the right distance to plant coconuts.

1.--More a tree of the size of the coconut palm, has of space and air, the better this will be to permit it to extend its leaves (fronds), by which much of its food is absorbed from the air and to grow luxuriantly and to become a heavy bearer of good sized fruits. The fronds

or leaves of the Coconut attain lengths of 12 to 15 feet at a nearer distance than 25 feet, the leaves would get entangled and deprive the plant of light which is an essential factor to its growth, it would grow up thin and slender and yield small fruits.

2.—Like all other plants, coconuts are liable to diseases. At a distance of 25 feet apart it will be more easy to isolate a plant attacked by bud-rot or some similar contagious disease and control the harm that can be done by destroying one or two trees—at a near distance, it is most likely that many more trees would have to be destroyed.

3.—When a Coconut plantation is symmetrically lined at equal distances at 25 feet, the work of gathering the crop and transporting it is facilitated.

From the proceedings of the Agricultural Society of Trinidad and Tobago, May, 1921.

ANNUAL REPORT ON THE WORKING OF THE BRITISH GUIANA SUGAR PLANTERS EXPERIMENT STATIONS' COMMITTEE FOR THE YEAR ENDING SEPTEMBER 30, 1920.

TO THE CHAIRMAN AND MEMBERS OF THE COMMITTEE OF THE BRITISH GUIANA SUGAR PLANTERS' EXPERIMENT STATIONS.

15th January, 1921.

GENTLEMEN,

Many efforts have been made in the past by the sugar planters of British Guiana to establish an experiment station scheme to continue and augment the classic investigations on sugar cane carried out by Professor Harrison at the Botanic Gardens, where the area of land and funds available have long been inadequate. All

these schemes fell through by reason of the failure of one or of a few estate proprietors to co-operate with the remainder. The Sugar Planters' Association finally decided to approach the Government with a view to resorting to legislation as a means of compelling all proprietors to co-operate in establishing an experiment institution. The Government having agreed to assist in this way, a permanent Committee was finally appointed by the Sugar Planters at the former's request, consisting of six members of the Association connected with sugar estate working, under the Chairmanship of Professor J. B. Harrison (who as Director of the Department of Science and Agriculture was appointed *ex officio*), to make all arrangements relating to the scheme, and with authority to make whatever appointments were considered necessary. This Committee met for the first time on June 30th, 1919, and consisted of Professor Harrison (Chairman), with Messrs. R. Strang, W. M. B. Shields, A. E. Bratt, J. C. Gibson, A. E. Craig, and R. E. Brassington. A draft Ordinance was discussed by this Committee in August and was finally passed by the Government on September 24th, 1919. This Ordinance (No. 29 of 1919) is termed "the Sugar Planters' Experiment Stations Ordinance, 1919" and was published in the "Official Gazette" of 30th September, 1919.

The Committee having first assessed the contribution of the estates to the fund for the current year at 33 cents per acre, proceeded to the appointment of a General Manager or Superintendent of the prospective stations. The post was offered to a previous applicant, Mr. W. W. Taggart, Assistant Director of the Louisiana Experiment Station. Mr. Taggart finally declined the offer for family reasons. The post was then offered to Mr. J. Crabtree of the Woburn Experiment Station England, and accepted by him. Mr. Crabtree arrived in the colony and assumed his duties on 4th April, 1920.

In the meantime the Committee decid.d at once to start a central station in or near Georgetown with a view to extending as rapidly as possible the promising varieties of cane then in cultivation in the Botanic Gardens which

had not had trials under estate conditions, and thus to lose no time in the search for, and production of, new varieties, this being regarded as one of the most urgent requirements of the sugar industry. Accordingly a piece of land in juxtaposition to the Botanic Gardens was surveyed by the Committee in December and leased for a period of ten years. This land was a portion of the western half-section of Plantation Sophia, an abandoned sugar estate owned by Messrs. Curtis Campbell & Co. This estate had been in cultivation from early times till 1891 when it was abandoned owing to factory troubles and heavy cost of sea defence. When in cultivation it grew heavy crops of cane; it was seen also to be well adapted for the purpose of a seedling nursery as the soil varied in texture from the typical heavy Demerara clay in the front of the estate to a somewhat lighter "medium" soil in the middle, with a typical sand reef cutting through at the back. This variation will give an opportunity for the seedlings raised being selected for their performances on these different classes of soil, which it had not previously been possible to do at the Botanic Gardens where the soil is all heavy. A 35 acre portion was first taken but was later increased to 51 acres so as to include a whole half-section: still later the eastern half-section was added, an area of about 60 acres, so that the whole amount now available is approximately 110 acres. During the 25 or so years of abandonment, a thick growth of bush and trees had arisen, particularly on the medium and lighter lands, the predominating species being :—

Trees	*Common name*
Mimosa asperata	
Cecropia peltata	Trumpet wood
Psidium pomiferum	Guava
Mangifera indica	Mango
Cordia umbraculifera	Clama cherry
Pithecolobium saman	
Inga dulcis	Whykee

Shrubs	*Common Name*
Flemingia congesta	Black sage
Cordia Aublettii	
Cassia bacillaris	Sweet sage
Lantana camara	Bastard jamoon
Ardisia humilis	
Palms	
Elaeis guineensis	African oil palm
Herbaceous	
Andropogon sp.	
Sporobolus sp.	
Cyperus sp.	
Desmodium incanum	
Clerodendron sp.	
Heliconia acuminata	
Climbers	
Securidaca volubilis	
Canavalia ensiformis	
Paullinia sp.	

The trenches were filled with a compact growth of Mucca-mucca.

Mr. J. P. Bastiaans was appointed field manager in February and a commencement then made with the clearing of the fields and dams and with the excavation of the trenches. By June the navigation and side-line trenches had been completed at a cost of $3.24 and $1.87 per rod respectively, and about 11 acres in the centre of the area cleared and half-banked ready for planting. A building comprising manager's office, watchman's house, and labourer's logie, had meanwhile been erected on the mid-walk dam, and a lift-up bridge constructed over the Lamaha Canal connecting Sophia with the Experimental Fields of the Botanic Gardens: the costs of these were respectively $1,561.86 and $632.26. The Station was then formally

opened on June 21st by His Excellency the Governor in the presence of a large attendance of people connected with cane sugar production. His Excellency planted the first cane tops and transplanted the first basketed seedlings on the Station.

In July and August the large number of different varieties of cane growing in the cane fields of the Botanic Gardens were cut and the whole of the tops available planted out at Sophia with the object of extending as rapidly as possible these varieties (already selected for performance in the Botanic Gardens in previous years), and trying them out on a larger scale and under different conditions. 640 varieties were thus obtained covering about 11 acres, in addition to about 2,000 selected seedlings raised in 1919. The areas of the varieties vary from a sixth of an acre down to single stools. Those occupying the larger areas will probably be drawn down in April 1921 for distribution to the estates for further trial there, the smaller will be drawn down and extended at Sophia at the same time: this refers, of course, to the promising varieties only. It is not proposed here to give a list of the seedlings planted out, as, until records of their performances are available, such list would be merely a more or less meaningless array of numbers.

Meanwhile the raising of new seedlings from arrows is being pushed forward both in the Botanic Gardens and at Sophia. They have been perforce obtained from arrows of seedlings now in general cultivation, and the arrows used have been collected from the estates. It has been noticed, however, in previous years that more promising seedlings are often obtained from arrows of the old named varieties, and in consequence special attention has been given to planting out as complete an assortment of these varieties as possible, for the sole purpose of obtaining arrows for raising seedlings in ensuing years.

The Superintendent has put himself in communication with the Experiment Stations in other sugar cane growing countries, and many of these have kindly

promised to send tops of their most promising cane varieties for trial in Demerara, a few of which have already been received. Several stations are issuing no cane at all owing to the incidence in their plots of the "Mosaic" disease mentioned below.

A collection has been started also at Sophia, of species of legumes or other vigorous plants with the object of finding one of possible value as green manure. Some indigenous species have already been obtained and other kinds are being imported. It is intended to obtain as complete a collection as possible so as to leave no stone unturned in this regard as the matter will be of considerable importance in the renovating of old cane lands.

It will not be possible to commence any manurial or other plot trials at Sophia while only small batches of seedlings are available, and the area is, as now, a complicated pattern of a large number of different varieties. It will, moreover, be necessary first to reduce, by taking off a few crops, the accumulated fertility of the soil produced by the 25 years' growth of bush upon it if the conditions are to be, as is necessary, similar to those under which cane is grown on the estates. For the purpose of manurial and cultural trials it is proposed to establish branch stations on the estates, in different parts of the colony, where these trials can be carried out under estate conditions and on the estate soils. This applies also to trials with mechanical tillage, which at Sophia could not at present be representative owing to the tangle of trees and bush roots in the soil, and to the original layout of the estate in very small beds which it is not worth while at present to alter. The location and organization of these sub-stations are now under consideration by the Committee. A small pamphlet, written by the Superintendent, was issued by the Committee in May, and distributed among the estates, describing the symptoms of the new Mosaic disease which has been spreading consternation among the cane growers, and havoc among the crops, in several cane growing countries.

The co-operation of all planters has been requested in reporting any suspected cases, early and vigorous elimination being necessary in the control of this disease. It is intended to circularise the estates in a similar way in regard to any new points which arise, of importance and interest to cane planters.

The Superintendent has, from time to time, visited the estates as opportunity has arisen, with the object of studying the present conditions of the cane industry in the colony. 21 of the 37 estates have been visited so far, and a complete tour will be effected in due course. As a result, a report dealing with these conditions and a discussion of the possibilities of development and improvement is being written.

Pending the acquisition of a laboratory and staff by the Committee, the Government, through Professor Harrison, has kindly placed the laboratories of the Department of Science and Agriculture at its disposal. Professor Harrison has also permitted the Superintendent to establish his office in the same buildings where also the Committee's meetings are held.

The balance sheet for the working of the financial year is submitted in the following two pages. It is necessary here to point out, the greater proportion of money expended has been in bringing new land into cultivation, and cannot be regarded as expenditure on actual experiment work; also the costs of clearing and cultivation at Sophia have been considerably greater than in estate work, due to the heavy nature of the bush cleared, the large amount of roots which could not be left to rot in the usual way, to difficulty in obtaining suitable labour at reasonable rates, and to the superintendence and multiplication of labour necessary in the cultivation of large numbers of small plots.

In view of the continuing heavy costs of establishment, the Committee at their September meeting recommended that the contribution of the estates for the

year ending September 30th, 1921, be assessed at $1.00 per acre: this was sanctioned by the Sugar Planters' Association in the same month.

In September also, the three retiring members, Messrs. Strang, Shields, and Gibson, were re-elected by the Planters' Association, so that the personnel of the Committee remains unchanged for the forthcoming year.

JAS. CRABTREE,
Superintendent.

LABOUR COSTS AT SOPHIA.

Clearing Dams	$ 316 44
Clearing Mucca-mucca from trenches	573 44
Digging navigation	1,852 28
Digging side-line (including removal old aqueduct, $343.28) ...	1,015 18
Digging cross canals and backing earth	395 40
Clearing fields of bush 18½ acres	474 91
,, ,, ,, trees ,, ,, ...	441 72
Digging drains, 17½ acres	182 94
Lining	106 16
Half Banking, 17½ acres	766 80
Planting 11 acres	658 12
Forking banks twice, 13½ acres	410 76
Weeding 5 times, 17½ acres	658 73
Transporting	515 26
Superintendence	384 09
Watchmen	187 42
Carpenter	177 96
Sundries	344 46
	$ 9,462 07

British Guiana Sugar Planters' Experiment Stations Committee.

STATEMENT SHOWING TOTAL RECEIPTS AND EXPENDITURE FOR YEAR ENDING 30TH SEPTEMBER, 1920.

Receipts.		Payments.	
Assessments on Sugar Estates	$21,954 24	Chairman	$ 889 73
Government contribution in lieu of assessments on cane farmers	300 00	Secretary	500 00
Refunds on motor car (Superintendent)	250 00	Assisant Secretary ...	300 00
Interest on Savings Deposit	52 50	Superintendent, Salary	1,888 00
		House	295 00
		Motor car	1,200 00
		Travelling	177 00
		Passage to Colony	470 00
		Field Manager, Salary	931 02
		Travelling	232 76
		Field Overseer ...	84 00
		Sophia Station— Wages	9,462 07
		Rent six months	250 00
		Office Buildings	1,779 86
		Boats	137 06
		Bridge	632 26
		Roadway	50 00
		Sundries	616 08
		Total payments	$19,894 79
		Balance in Colonial Bank, current ac.	111 45
		Balance in Colonial Bank, Savings deposit	1,052 50
		Balance in Colonial Bank, Superintendent and Secretary Account	1,498 00
Total	$22,556 74	Total	$ 22,556 74

PLANTS WORTH KNOWING.

By J. F. Waby.

Bomarea edulis, a native of Trinidad, a very pretty and useful scandent herbaceous, soft-wooded plant with somewhat the appearance of *Gloriosa superba*, growing to about 5 feet 6 inches to 6 feet high, with many pipe-like stems which twine rather than cling, there being no tendril at the end of the foliage, the growth being closely centred rather than spreading as does the *Gloriosa*. Stems $\frac{3}{16}$ inch thick, soft, pale green, foliage pale green almost sessile, what stem there is being twisted, lanceolate, acuminate, 5 inches long, one inch wide at the widest part, midrib prominent above, several closely running parallel veins on either side, set $1\frac{1}{2}$—2 inches apart on various sides of the stem. Inflorescence at point of growth, where there are several leaves formed in a whorl, above which radiate 6 flower stalks rather larger than whipcord, of a slightly brownish tinge; these are $3\frac{1}{2}$ inches long to the first flowers where there is a small lanceolate green bract; the second branching is a little shorter and the third shorter still; the flowers are borne solitary, each peduncle being $1\frac{1}{2}$ inches long; ovary small, green; the individual flowers are $1\frac{1}{2}$ inches long, with a spread at top of $\frac{3}{4}$ inch; composed of 3 outside, pink, oblong segments $1\frac{1}{4}$ inches long, with a green tip and sharp centre as if they had been folded, the base of the joined petals only $\frac{1}{4}$ inch wide. The inner 3 segments are petaloide, the lower half narrow and folded, the upper half broadly spathulate, flimsy, green with brown markings, 6 stamens 1 inch long, filaments inside the folded portion of the inner segments; the anthers club-shaped $\frac{3}{8}$ inch long, dark brown.

The capsule triangular, $\frac{3}{4}$ inch long, $\frac{1}{2}$ inch wide, top flattish, a ridge all round, dehiscing in 3 valves, the seeds attached to the centre of each valve.

On first seeing this plant one is reminded of the lovely Brazilian Lily—*Lapageria rosea*, growing in the green-houses in England. The inflorescence of this *Bomarea* is a miniature *Lapageni.*

Parkia biglandulosa, a handsome tall growing tree with a splendidly formed head of strong branches, forming a good shade tree for our streets. The foliage is very fine, fern-like, bipinnate, 15 inches long, pinnae in 20 pairs, pinnules in 44—54 pairs, $\frac{1}{4}$ inch long, $\frac{1}{16}$ inch wide, dark green. A large double gland at the base of the leaf-stalk and 2 or more small glands at the base of the upper pinnae. Inflorescence terminal, 1-6 flowers. Individual flower-stalks 7-10 inches long, strong pendant, flowers aggregated in balls at the end like drum-sticks, a close fringe of whitish filaments $1\frac{1}{4}$ inches diameter and $\frac{1}{4}$ inch wide, the remainder of the ball $2\frac{1}{2}$ inches long, $1\frac{3}{4}$ inches diameter composed of tiny individual flowers; globose heads $1\frac{3}{4}$ inches deep and across, depressed part 1 inch long and same diameter. From the nucleus of the inflorescence which may be about 1 inch in diameter, after the fall of the essential organs, there spring fruits, 1. 2, 3 or more, 9-10 inches long, $1\frac{1}{2}$ inches wide—(stalk 3 inches)—$\frac{1}{4}$ inch or more thick, dark brown, seeds showing plainly. These are very similar in size and colour to those of the Devil's Ear seeds.

The small wild "Karaila," *Momordica Balsamina* common all through the West Indies. In British Guiana it is of little account, growing, flowering and fruiting in the country along the Railway and other fences in the wet season, and drying up in the dry season. In Trinidad it is seen at its best, forming high screens where objectionable out houses, etc., are to be shut out of sight, making a pleasant object without trouble, wire netting or even single wires placed closely, and it is astonishing how quickly a pleasant screen is formed with its pale green, small palmate foliage, pretty little pale yellow flowers and bright orange-coloured fruits. Like the other momordicas it bears monaecious flowers, both male and female flowers being of the same colour and

size. Foliage palmate, deeply cut, $1\frac{3}{4}$ inches across tapering inwards, a spiral tendril opposite, filiform $1\frac{1}{2}$ inches apart, pale green. Inflorescens solitary, male flowers 1 inch across, peduncle $1\frac{1}{4}$ inches long, filiform; corolla bright yellow of 5 petals. Column of stamens $\frac{1}{4}$ inch high and across, of a darker yellow, calyx pale green, $\frac{1}{2}$ inch across of 5 sepals. Female flowers of similar colour and size. Ovary $\frac{5}{16}$ inch diameter, fluted green, column above ovary $\frac{1}{4}$ inch long. Gynaecium $\frac{1}{4}$ inch high, divided filiform. The perfected fruit 2 inches long $1—1\frac{1}{8}$ inches wide, pointed. Shewing the filiform gynaecium, tuberculus with short teeth in 8 or 9 lines from end to end. Orange coloured. If opened before dehiscense takes place, it is found to be filled with 3 rows of seeds closely packed together, these covered with a thick red, sticky putamen. It dehisces in 3 sections; these throw themselves backwards—literally turning inside out—carrying the red seeds fixed in 2 rows on each section, which fall off early. East Indians use these fruits in their cookery.

Ochroma Lagopus, "Bois Flôt," "Bois Tabal," "Bombast Mahoe," "Corkwood," "Down tree," of the West Indies generally, specimen the soft, short, downy mouse-coloured cotton substance. The capsule before detriscense takes place is 9 inches long, and nearly 2 inches diameter, with 10 longitudinal corrugations forming into 5 valves, turning dark brown. As soon as ripe dehiscense takes place, the valves fall off cleanly, leaving the downy substance, which remains on till the wind blows it to pieces, carrying the small brown seeds with it to the ground. As the valves fall off the downy substance expands to quite double the diameter of the closed capsule, still showing the longitudinal marks of the dropped valves. The stalk which holds the fruit (the peduncle) is quite stout, $\frac{1}{2}$ inch thick and 6-8 inches long. Inflorescence terminal, solitary; flowers 3-4 inches long, erect pale yellowish white. Involucre 3-leaved, deciduous, calyx funnel shaped coriaceous, of a reddish colour. Petals twice

the length of the calyx, linear-oblong, wedge-shaped at the base with the limb somewhat expanded, thin, longitudinally veined, puberulous, undulated. Filaments united to form a simple cylindrical, angular column, anthers 5, cohering, spirally twisted, 5-fid at the apex. Ovary conical, 5-sided, style cylindrical, 5-sided enclosed in the tube of the filaments, stigmata 5, an inch long protruding beyond the anthers spirally twisted. Foliage cordate with sloping shoulders and 3 points, 9-12 inches long, 9-10 inches wide, dark green above, glabrous beneath; 7 main ribs radiating from the petiole with well marked straight veins running from these and finer straight veins connecting them, still finer veins connecting the latter—a beautiful specimen of veining—all of a pale yellowish brown on the under surface. Petiole 9·12 inches long. The silk-cotton of the pod is used for making pillows and other articles which require padding, it is admirably adapted for this purpose as it is so beautifully soft. The wood being so light and tough is largely used in the building of Airplanes, and is splendid substitute for cork for entomological work. Specimens from the woods of Trinidad.

Portlandia grandiflora, from Jamaica. A fairly large growing shrub, much like a Magnolia in appearance, very floriferous, with straightish branches, pyramidal. Foliage oblong, dark green shining, $4\frac{3}{4}$—$5\frac{1}{2}$ inches long, $2\frac{1}{4}$—3 inches wide, pointed, leathery, in pairs. An ochrea surrounds the stem, at each pair of leaves. Inflorescens solitary,—though in quantity,—flowers tubular, 6 inches long, base 5 square, $\frac{1}{4}$ inch wide with green corners, enlarging in the tube to $1\frac{1}{4}$ inches wide with deep pink corners. The mouth campanulate with 5 broad and pointed segments $2\frac{1}{4}$ inches across; general colour whitish tinged with pink, the corners, which are a continuation from the segments to the base of a deep pink colour meeting the green corners more than half way down,—5 filiform stames reaching to the base of the segments, lower $\frac{2}{3}$ white, upper $\frac{1}{3}$ yellow. Pistil

rather shorter than the stamens, filiform with a green stigma. A deep chocolate coloured calyx, stem 1 inch long, 5 oblong, pointed segments $\frac{5}{8}$ inch long. The fruit, small guava-like with 5 corners the calyx segments superimposed.

THE MOSQUITOES OF BRITISH GUIANA.

By G. E. Bodkin, B.A., Dipl. Agric. (Cantab), F.E.S., Assistant Director and Government Economic Biologist, Department of Science and Agriculture, British Guiana.

Previous local publications on the Mosquitoes of British Guiana consist in the work of Drs. Rowland and Low commencing in 1889 and, later, that performed by the Rev. Aiken and Dr. Rowland. The results of these investigations are contained in the British Guiana Medical Annual for the years 1905, 1906, 1908, 1913 and also in "Timehri," the Journal of the Royal Agricultural and Commercial Society of British Guiana, in July, 1911.

A list of the British Guiana Mosquitoes was published in the Journal of the Board of Agriculture Vol. VIII July, 1915, by F. W. Urich, Entomologist to the Board of Agriculture, Trinidad.

The present condensed list is practically a revision of all previously published lists of British Guiana mosquitoes and it has been drawn up with the aid of Howard, Dyar and Knab's exhaustive monograph on the Mosquitoes of North and Central America and the West Indies.

The nomenclature and classification utilized in this paper is based entirely on this monograph, by its aid it has been possible to make corrections in the locally published,

earlier lists; these corrections materially reduce the number of recorded species. The object of this contribution is to record, in the light of recent researches into the identifications and classifications of this family of Insects, as accurate a list as possible of the present, known species of Mosquitoes in British Guiana, and also to provide, for future investigators, an up to date basis upon which to work.

In preparing this list I am partly indebted to the work of my late Assistant Mr. L. D. Cleare, Jnr., to whom, prior to his leaving this Division, I had delegated the preparation of this paper. Mr. H. W. B. Moore has supplied some valuable notes and information.

SUB-FAMILY CULICINAE.

TRIBE SABETHINI.

Genus Sabethes. Robineau- Desvoidy.

1. *Sabethes tarsopus.* Dyar and Knab.

Two specimens exist in the collection of the Biological Division of the Department of Science and Agriculture. (British Museum identification.) Collected by C. B. Williams, Issororo, North Western District, June 1916. The species is diurnal and will bite man. The locality from which these specimens came is well within the forest area at an elevation of about 150 feet. (Howard, Dyar, and Knab. Vol. 3. Part. i. p. 25.)

2. *Sabethes cyaneus.* (Fabricius) Knab.

Recorded from British Guiana by Theobald who states. "Dr. Low took his specimens in virgin forest during the day." Specimens of this insect are in the British Guiana Museum with a locality " Hyde Park, Demerara River." (H. D. K. Vol. 3. Part i. p. 26.)

3. *Sabethes schausi.* Dyar and Knab.

A single female has been collected at Omai, Essequebo River, by Mr. William Schaus. This is the only record from British Guiana.

4. *Sabethes chiopus.* Dyar and Knab.

A single male has been collected in the Potaro Highlands by M. A. De Freitas in May, 1909. This is the only record from British Guiana.

(Dyar and Knab. Insecutar Insectae Men. I. 6th. June, 1912.)

Genus Sabethinus. Lutz.

5. *Sabethinus undosus.* Coquillet.

Howard, Dyar and Knab record this species from British Guiana as follows:—Georgetown, British Guiana. Adult captured August 1st (Dr. E. D. Rowland.) Aiken (B. G. Medical Annual 1908 p. 18) says:—Specimens of these mosquitoes were obtained by Dr. K. S. Wise from the Kanuku Mountains. (H.D.K. Vol. 3. Part i p. 33.)

Genus Sabethoides. Theobald.

6. *Sabethoides nitidus.* Theobald.

Specimens of this insect are in the British Guiana Museum with the localities Dora, Demerara River, July 1908, (M. A. DeFreitas) and Potaro, May, 1909 (M. A. De Freitas). It has also been taken in British Guiana by Dr. Low. (H. D.K. Vol. 3. Part i. p. 37)

Genus Limatus. Theobald.

7. *Limatus durhami.* Theobald.

The following localities have been given for this species :—Potaro, British Guiana, May, 1909 (H. W. B. Moore) recorded in H. D. and K.

Rupununi, Collected by K. S. Wise. Recorded by Urich in Journal of the Board of Agriculture, British Guiana. Vol. VIII July, 1915. No. 3.

Georgetown, Essequebo Coast, East Bank, Demerara river (H. W. B. Moore).

The species has been bred by H. W. B. Moore from larvæ collected in the sheathes of the Awarra Palm. (*Astrocaryum tucumoides*) (H. D. K. Vol. 3. Part i. p. 42.)

Genus Wyeomyia. Theobald.

8. *Wyeomyia melanocephala.* Dyar and Knab.

This species has been collected in the Rupununi by K. S. Wise (Urich, Journal of the Board of Agriculture of Britsh Guiana. Vol. VIII. July 1915. No. 3.) (H. D. K. Vol. 3. Part i. p. 86)

9. *Wyeomyia pseudopecten.* Dyar and Knab.

A specimen of this insect is in the collection of the Biological Division, Department of Science and Agriculture. (British Museum identification). It was bred from the water contained in Heliconia plants. A commonly occurr-ng species in this district. Issororo, North Western District. G. E. Bodkin, June, 1915. (H. D. K. Vol. 3 Part i. p. 119.)

10. *Wyeomyia bromeliarum* Dand K.

Recorded by Theobald from British Guiana, 1903 also collected by Bodkin and Cleare in the Shelter Belt, Botanic gardens 5. 5. 15. One specimen in the collection of the Biological Division (British Museum identification) (H. D. K. Vol. 3. Part i. p 131).

11. *Wyeomyia chrysomus.* Dand K.

The following localities have been given for this species:—Morawhanna, North Western District, and Demerara River. (Dr. Low in Theobald)

New Amsterdam (Dr. Rowland in Theobald)

Hollandia, Upper Berbice River (Aiken). Aiken has taken the larvæ in the scoop-like bract of a flower of Ravenala sp. (H. D. K. Vol. 3. Part i. p. 70)

12. *Wyeomyia luteoventralis.* Theobald.

Theobald records this species from British Guiana and remarks: The specimens taken by Dr. Low were caught in the forest near the Demerara River at 12 noon in subdued light.

13. *Wyeomyia aporonoma* Dyar and Knab.

Recorded by Urich as having been taken by H. W. B. Moore in Georgetown. (Journal, Board of Agriculture, British Guiana Vol. VIII No. 3. July 1915) (H. D. K. Vol. 3. p. 73)

14. *Wyeomyia chreseta.* Dyar and Knab.

Collected by H. W. B. Moore at Craig, East Bank, Demerara River, Essequebo, West Coast, Demerara. (H. D. K. Vol. 3. Part i. p. 139).

Tribe Culcicini.

Genus Culex Linnaeus.

15. *Culex similis.* Theobald.

Two specimens exist in the collection of the Biological Division. Collected at Pln. Blairmont, Berbice. G. E. Bodkin, November, 1920, British Museum identification) (H. D. K. Vol. 3. Part i. p. 342)

16. *Culex quinquefasciatus.* Say.

This well known species is prevalent throughout the coast lands of British Guiana.

Breeds freely in cesspits in Georgetown and other localities. (H. D. K. Vol. 3. Part i. p. 357)

17. *Culex conspirator.* D and K.

A single specimen of this insect is in the collection of the Biological Division with the following data: Bred from larvae collected in the Botanic Gardens, Georgetown. G. E. Bodkin. L. D. Cleare Jnr. 1. 5. 15 (British Museum identification) (H. D. K. Vol. 3 part i. p. 410)

18. *Culex lateropunctata* Theobald

Recorded from British Guiana by Theobald. (Mono. Culicid iv. 1907. p. 458)

19. *Culex corniger* Theo.

Recorded by Dr. Rowland from Stanleytown, New Amsterdam, British Guiana. Described by Theobald as

Trichopronomyia microannulata. Theobald. (Theobald. Mon. Culicid. iv. 481. 1907.) (H. D. K. Vol. 3. Part i. p. 240).

20, *Culex luteoplurus,* Theobald,

Recorded by Aiken and Rowland (British Guiana Annual, 1905, 1906, 1908, 1911).

21. *Culex indecorabilis,* Theobald.

Recorded by Aiken and Rowland. (British Guiana Annual, 1908, 1911.)

Genus Mansonia. Blanchard.

22. *Mansonia fasciolatus.* Dand K.

Recorded from Schepmoed and Stanleytown, British Guiana, (Rowland) Rupununi, (K. S. Wise) Botanic Gardens, Skeldon, Anna Regina, Craig, Nonpareil, Ida Sabina. (H. W. B. Moore) (H. D. K. Vol 3. Part i. p. 513).

23. *Mansonia titillans* (Walker) Blanchard.

Recorded from Berbice (Aiken) Georgetown. (H. W. B. Moore) (H. D. K. Vol. 3. Part i. p. 517)

Genus Psorophora. Robineau Desvoidy.

24. *Psorophora cilipes.* (Fabricius). Dyar and Knab.

Two specimens are in the collection of the Biological Division. (British Museum identification) Both from Onderneeming, Essequebo (G. E. Bodkin). The species has also been recorded as follows:—Sipuruni Creek, Essequebo River (K. S. Wise) Potaro (De Freitas) Ida Sabina, Berbice (Moore) (H. D. K. Vol. 3. Part 2. p. 538.)

Sub-genus Janthinosoma. Arribalzaga. Lynch.

25. *Psorophora posticatus.* Wild.

Two specimens are in the collection of the Biological Division (B. Museum identification) with the following note Bred from larvæ collected in stagnant water containing many dead leaves. Larvæ swarming. Shelter Belt,

Botanic Gardens. 7. 5. 15. G. E. Bodkin. It has also been recorded from Berbice (Aiken) and Georgetown (Rowland). (H. D. K. Vol. 3. Part 2. p. 348)

26. *Psorophora lutzii.* Theo.

This species is recorded by Howard, Dyar and Knab from British Guiana as follows :—Rupununi (K. S. Wise). It is also recorded by H. W. B. Moore from Lodge Village (Near Georgetown) 28. 10. 09 and Potaro. May, 1910. De Freitas. (H. D. K. Vol, 3, Part 2. p. 557)

27. *Psorophora cingulatus.* Fabricius.

Recorded from British Guiana by Theobald. (H. D. K. Vol. 3. Part 2. p. 597)

Genus Aedes. Meigen

28. *Aedes fulvus* (Weidemann) Knab.

Recorded from British Guiana by Aiken(H. D. K. Vol. 3. Part 2. p. 624)

29. *Aedes taeniorhynchus* (Wiedemann) Busck.

Several specimens of this insect are in the collection of the Biological Division (British Museum Identification). It is a very common species and has been recorded from most parts of the coastlands of British Guiana (H. D. K. Vol. 3 Part 2. p. 667)

30. *Aedes nubilus.* (Theobald.) Howard, Dyar and Knab, record this species from British Guiana as follows: Rupununi. (K. S. Wise) (H. D. K, Vol. 3. Part 2. p. 783).

31. *Aedes scapularis* (Rondani) Pazos.

Recorded from British Guiana by Rowland and Aiken. Several specimens are in the collection of the Biological Division. (British Museum identification) from Berbice and Botanic Gardens, Georgetown. (G. E. Bodkin and L. D. Cleare, Jnr.) (H. D. K. Vol. 3 Part 2. p. 783)

32. *Aedes pertinax.* Grabham.

Recorded from Botanic Gardens, Georgetown, May 1915. (Bodkin and Cleare) (H.D.K. Vol. 3. Part 2. p. 791).

33. *Aedes serratus.* (Theobald) Dyar and Knab.

Recorded from British Guiana by Rowland and Aiken (H.D.K. Vol. 3. Part 2. p. 794).

34. *Aedes argenteus.* Poiret.

Specimens of this mosquito are in the collection of the Biological Division (British Museum identification). It has been recorded all along the coastlands of British Guiana, (H.D.K, Vol. 3. Part 2. p. 827).

Genus Haemagogus. Williston.

35. *Haemagogus splendens.* Williston.

Recorded from British Guiana by Theobald. (H.D.K. Vol. 3. Part 2. p. 865).

36. *Haemagogus albomaculatus.* Theobald.

One specimen of this mosquito is in the collection of the Biological Division. (British Museum identification). Locality—Issororo, North Western district. G. E. Bodkin, June 1915. Recorded also from British Guiana by Theobald. (H.D.K. Vol. 3. Part 2. p. 868).

37. *Haemagogus equinus.* Theobald.

Recorded from British Guiana by Rowland 21. 1. 06. (H.D.K. Vol. 3. Part 2. p. 871).

38. *Haemagogus capricornii.* Lutz.

Recorded from Tumatumari, Potaro, British Guiana by Bodkin. December 1916. (British Museum identification) (H.D.K. Vol 3. Part 2. p. 867).

Genus Orthopodomyia. Theobald.

39. *Orthopodomyia fascipes.* Coquillet.

Recorded by Howard, Dyar and Knab from British Guiana as follows:—Omai, British Guiana (K. S. Wise) (H.D.K. Vol. 3. Part 2. p. 882).

Genus Aedeomyia. Theobald.

40. *Aedeomyia squamipennis.* (Lynch Arribalzaga.) Theobald. Recorded from British Guiana by Aiken and Moore. Several specimens are in the collection of

the Biological Division (British Museum identification.) Recorded from Botanic Gardens, Georgetown. (Bodkin and Cleare) and from Berbice, British Guiana. (Bodkin). (H.D.K. Vol. 3. Part 2, p. 894).

Genus Uranotaenia. Lynch Arribalzaga.

41. *Uranotaenia pulcherrma.* Lynch Arribalzaga.

Recorded by Howard, Dyar and Knab from British Guiana as follows:—Georgetown, (H. W. B. Moore). (H.D.K. Vol. 3. Part 2. p. 908).

42. *Uranotaenia lowii.* Theobald.

Recorded from British Guiana by Aiken and Rowland (Berbice and Georgetown) (H.D.K. Vol. 3. Part 2. p. 911).

43. *Uranotaenia geometrica.* Theobald.

Several specimens are in the collection of the Biological Division (British Museum identifications). One specimen has attached note " Pupae in artesian well water trench (Rice irrigation, surface thereof covered with scum and Salvinia) D'Urban Park, Georgetown. L. D. Cleare jnr. 30. 4. 18. Recorded also from British Guiana by Moore and Bodkin (Georgetown and Berbice). Also by Rowland. (H.D.K. Vol. 3. Part 2. p. 918).

44. *Uranotaenia rowlandii.* Theobald.

Recorded from New Amsterdam, British Guiana by Theobald (Mono Culicid in p. 566. 1907.)

45. *Uranotaenia leucoptera.* Theobald.

Recorded from British Guiana by Theobald. (Mono Culicid iv.p. 575. 1907.)

GROUP MEGHARINES.

Genus Megharinus (Robineau—Desvoidy.).

46. *Megharinus superbus.* Dyar and Knab.

A specimen of this insect is in the collection of the Biological Division (British Museum identification) from Essequebo (Bodkin) Recorded also from British Guiana by H. W. B. Moore and Siparuni Creek, Essequebo River, (Wise) H.D.K. Vol. 3. Part 2. p. 932.

47. *Megharinus separatus.* Arribalzaga.

Recorded from British Guiana by Aiken (B.G. Med. Ann. 1905. pp. 15 & 36.)

48 *Megharinus haemorroidalis.* Fab.

Recorded by Urich (Journal, Board of Agriculture, British Guiana Vol. VIII. No. 3. July 1913) from British Guiana as follows:—Omai. (K. S. Wise) Siparuni Creek (Wise.)

GROUP ANOPHELENES.

Genus Anopheles Meigen.

49. *Anopheles argyritarsis* Robineau—Desvoidy

Several specimens of this mosquito are in collection of the Biological Division (British Museum identifications). They are recorded from Potaro. (Bodkin). They are also recorded by Aiken from New Amsterdam, and Botanic Gardens, Georgetown, L. D. Cleare, Jnr. (H. D. K, Vol.3. Part 2. p. 967).

50. *Anopheles tarsimaculata.* Goeldi.

Specimens of this Anopheline are in the Biological collection from Botanic Gardens, Georgetown, Berbice, East Bank, Demerara. (G. E. Bodkin). They are also recorded from Berbice by Aiken and Rowland. (H. D. K. Vol. 3. Part. 2. p. 967)·

51. *Anopheles lutzii.* Theobald.

Recorded from British Guiana by Dr. Low—Coriabo, Barima River, North Western District. (H. D. K. Vol. 3. Part 2. p. 971.)

52. *Anopheles mediopunctatus.* (Theobald.) Dyar and Knab.

Recorded from British Guiana by Theobald. (H. D. K. Vol. 3. Part 2. p. 993).

53. *Anopheles nimba.* Theobald.

Recorded from British Guiana by Theobald (Mono. Culicid p. 62. 1903).

54. *Anopheles nigra*, Theobald.

Recorded from British Guiana by Theobald also Aiken. (British Guiana Medical Annual 1908. pp. 3, 4, & 22.)

How to Make Farm Machinery Last.

1. Learn every adjustment and its purpose.

2. Oil all bearings, gears, shafts, etc., where there is friction.

3. Keep all machinery housed and give each implement a coat of paint at least every two years.

4. Keep all bolts and nuts tight and snug.

5. Grease all landsides, mouldboards, shares, cultivators, shovels, and discs when they are to be out of use more than two or three days.

BOTANICAL, PLANT DISEASES AND PEST NOTES.

Report on Malarial Mosquitoes in the Potaro District.

Biological Division,
7th February, 1921.

Sir,

I have the honour to submit herewith my report on the mosquito survey of the Potaro District.

I left Georgetown on21st January, 1921, and returned on 31st January, 1921. I was accompanied by Mr. F. Stell, Assistant Government Botanist and Mycologist; this Officer was of material assistance in performing the somewhat arduous work at times entailed by this survey. Our thanks are due to Brigadier-General Rice for courteously granting us every facility for the successful prosecution of the work. Our movements were hindered on some days by heavy and persistent rain.

2. The following places were most carefully investigated. A large number of human habitations along the Potaro road from the landing up to 16th Mile, the entire headquarters of the Minnehaha Development Company at 10 miles and also 15 miles and the Government Compound containing Court House, Rest House, Hospital, Police Quarters, and Post Office at 11½ miles along with its environments. During the investigation the following points were observed, (1) the particular pieces of water, either stagnant or running, which were breeding mosquitoes: (2) the species of mosquitoes concerned. The usual technique with regard to dipping and breeding larvae was observed.

3. As the headquarters of the Minnehaha Development Company at 10 miles are now the most populous centre of the Potaro it may not be out of place to detail the various enquiries made here. During the first night of our stay in these quarters I was immensely surprised to observe that they were infested with a species of Anopheles mosquito which, on examination, I had no hesitation in

identifying as the common malaria-bearing species *Anopheles argyritarsis R.D.* Its presence was all the more surprising to me as I have only on one previous occasion observed this species of mosquito at any distance from the coastlands: I refer to Rockstone, the terminus of the Wismar-Rockstone railway, where it is of common occurrence and the locality bears a sinister reputation for malarial infection.

A careful inspection was made of the environments of the quarters at 10 miles and I was successful in detecting the breeding-place of these Anopheles mosquitoes.

Not far from the house, and surrounded by vegetation was a great pile of empty tins some of recent origin, others almost ancient. Nearly all contained water which was kept constantly fresh owing to the drippings from the surrounding vegetation: the annual Potaro rainfall consists of some 150 inches. Some of the larger and older tins supported vegetation and in these receptacles particularly the larvae of *Anopheles argyritarsis, R.D.* were to be found.

The soil in this vicinity does not hold water for any length of time and natural accumulations of water as might be occasioned by drains, etc., do not exist owing to the fact that behind the house the ground slopes sharply downwards. At the foot of this incline there is a creek of some size and a number of pits caused by gold workings in days gone by. I examined these pits and the creek but was unable to detect the presence of mosquito larvae. In both the water was discoloured and the margins were grass-grown.

The various dwellings and other erections such as stables, machine-shop, bakery, store, etc., were examined In every instance I was struck by the entire absence of any effort whatsoever either to screen receptacles for collecting rain water or to do away with the mounds of empty tins, flasks and bottles. Many of the rain water barrels and tubs were literally alive with mosquito larvae which consisted almost solely of *Aedes argenteus*, Poiret. and *Culex quinquefasciatus*, Say. While the larvae of the previously mentioned species of Anopheles was not uncom-

mon. Similar conditions prevailed at every dwelling-house which was inspected throughout the Potaro. During the two nights which were spent at the quarters of the Minnehaha Development Company at 15 miles I was unable to detect the presence of Anopheles mosquitoes; this, despite the fact that a careful watch was maintained till late at night. Our inspections of the streams in the neighbourhood were also unsuccessful. Many of the dwellings along the Potaro road, about a mile from our quarters, were breeding mosquitoes however.

I was particularly interested in the large Government Compound at 11½ miles which, I understand, has a particularly unenviable reputation for malaria.

We closely inspected the whole compound and only a few empty tins were detected. Receptacles for rain water were in a satisfactory condition. In fact, the whole compound can be said to be practically free from mosquito-breeding conditions, yet malignant malaria was prevalent and several people testified to the presence at night of the species of mosquito locally known as "galli-nippers" which I well know to be none other than Anopheles.

About 100 yards from one side of the compound a small greatly grass-grown stream of clear water flows under a bridge across the road and it is from this source that the supply of *Anopheles argyritarsis, R.D.* is derived. A few dips of the ladle demonstrated their presence in considerable numbers. It is thus possible for a patient to be admitted to this Hospital and therein contract malarial fever.

4. *General Remarks and Conclusions*: (1) The malarial carrying mosquito *Anopheles argyritarsis, R.D.* is prevalent in the Potaro District in the vicinity of the Potaro road.

(2) It breeds in old tins and other receptacles lying in heaps beneath vegetation where, owing to the rainfall, a constant supply of fresh water is available. In one instance it was observed to breed in a clear water stream much overgrown with grass. In fact the Potaro is a district of empty tins, flasks, bottles, tubs and barrels. It must be borne in mind that the food and drink supply of the district

has, owing to its distance from civilized centres, to be conveyed in such receptacles.

(3) Potaro fever is well known but the cause, as far as I know, has hitherto remained shrouded in mystery. The detection of the malarial carrying mosquito and the fact that it is present in considerable numbers explains the origin of this fever; the climatic conditions of the Potaro may possibly aggravate the malaria when once contracted; its source, however, is sure.

5. The following species of mosquitoes were taken during our stay in the district. There are some others which I am unable to identify personally and which will have to be forwarded to the Imperial Bureau of Entomology—

Anopheles argyritarsis, *R.D.*
Aedes argenteus. Poiret.
Culex quinquefasciatus. Say.
Sabethoides nitidus. Theo.
Limatus durhami. Theo.
Uranotaenia geometrica. Theo.

I have the honour to be,
Sir,
Your obedient Servant,
G. E. BODKIN,
Government Economic Biologist,

THE DIRECTOR OF SCIENCE AND AGRICULTURE.

A SIMPLE POLLINATING APPARATUS.

In the *Agricultural Journal of India*, Vol. XVI. Part II, T. S. Venkatraman describes a simple apparatus devised by him for pollinating sugar-cane arrows at the sugar-cane breeding station, Coimbatore.

Pollen to be used is collected in tiny gelatin capsules such as are used by druggists for the administration of unpalatable medicines. The arrow of sugar-cane to be cross-pollinated is then selected, and the pollen-charged

capsule is inserted at the tube end of a 'blowing-'ball such as is used on perfumery bottles. By means of a darning needle, a puncture is then made at the posterior end of the capsule, and through this small hole the pollen can be conveniently and naturally sprayed in the neighbourhood of the recipient stigmas.

It is stated that both the pollen collecting and the spraying should only be done during reasonably dry weather.

It is also important that sugar-cane pollen can be repeatedly tested for viability. Sugar-cane poven germinates freely on the stigmas of *Datura fatuosa*, far *alba*, Mr. Venkatraman states.

The apparatus can be used for all kinds of pollen, and it should certainly facilitate manipulation in this often tedious and trying operation.

THE ORIGIN OF THE COCO-NUT PALM.

Studies in the origin of cultivated plants are exceedingly interesting, historically as well as botanically. In fact, it can be affirmed that such studies are in the broad sense, essentially historical, embracing as they do, ethnology, or the origin of human races, agricultural history and the historical side of botany. And the results of such studies can be useful as well as interesting. They furnish us with information as to what are the proper ecological conditions or 'surroundings' demanded by domesticated species under natural conditions, and they give an insight into methods of plant dispersal, and into the physiological or functional significance of certain specific characters. From the standpoint of tradition, it is inspiring to the present inhabitants of a region to find that their territory is the native home of a useful plant, and still more inspiring the fact that the former inhabitants—perhaps or perhaps not their ancestors—were responsible for bringing that useful plant under domestication, and disseminating

it to other places where it proved of great benefit to mankind.

The approximate region of origin of many cultivated tropical plants, of both major and minor importance, are definitely known. For example, Indian corn (or maize) and cacao undoubtedly originated in Central America; the sugar-cane in the east of India or Cochin China; the banana in Southern Asia.* But we do not possess indisputable evidence in connection with every cultivated plant and a striking example is to be found in the case of the coconut.

Attaching to the coconut is much romance: its obscure origin; its indispensability to the Polynesians from pre-historic times up to the present day; its relative unimportance to the people of tropical America; and lastly, its phenomenal increase in importance during the last twenty years in manufacturing industries of northern countries. And there are several very popular and fixed ideas concerning the coconut: it is generally pictured 'at home' fringing the shores of tropical islands, and the idea is also general that the fruit is specially adapted for dispersal by ocean currents. These considerations arouse a natural desire to know exactly how the coconut originated, and what are and have been its relationships to mankind in respect of dispersal. It has certainly played, and continues to play, a very important part in human history and economics.

So far as we are aware, the two most recent and competent contributions to the origin of the coconut are by O. F. Cook,† and O. Beccari.‡ Cook's memoir is by far the most exhaustive study of the subject, and maintains an American origin of the species; Beccari's paper is mainly a *critique* on Cook's paper, but it raises questions of importance which are not fully dealt with by Cook: Beccari holds the view that the coconut is of Asiatic origin. In addition to the views of these two botanists, we also

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*De. Candolle: 'Origin of Cultivated Plants,' 1909.

†The Coconut Palm in America': O. F. Cook: *Contributions from the United States National Herbarium*, Vol. 14 pp. 271-342 (1910).

‡' The origin and Dispersal of *Cocos nucifera*': O. Beccari. *The Philippine Journal of Science*, C. Botany, Vol. XII, No 1. Jan. 1917

have Copeland in the Philippines adhering to the American origin, and Wester, also in the Philippines, holding Beccari's view of an Asiatic origin Apparently the views of Copeland and Wester are not based on any original enquiry of their own.

Cook's arguments are briefly as follows: He points out that all other members of the family Cocoineae, except the African oil palm (*Elaeis guineensis*), are American. From this he argues that the member under consideration—the coconut (*Cocos nucifera*)—is also likely to be American. Next, by research into early literature, he brings evidence to show that the coconut existed in tropical America (including Columbia) prior to the arrival of the Portuguese and Spaniards, and by this evidence shows that the species was not introduced by the early European settlers. He adduces evidence to show that some of the Central American aboriginal tribes have the name 'ko-ko,' which applies to the coconut, as well as other names. Cook considers that the name 'coco' is of American origin and was not introduced from the East. He then endeavours to prove that the coconut is not able to maintain itself, without the aid of man, or seacoasts, as is evidenced by conditions in the Cocos Islands. He states that the fruit of the coconut is adapted for germinating under semi-desert conditions, and that the circumstance that the fruit floats is merely incidental. The coconut, he says, thrives well in interior localities (alkaline soils) at the present day (*e.g.*, interior of Columbia and Guatemala). A further point Cook makes is that several special Cocoineae have been domesticated in Central America. This indicates the interest taken, and the importance which the aboriginal American Indians attached to the palms.

Cook next brings evidence to show that the Polynesians visited the Pacific coast of Panama and Columbia in pre-historic days.*

*The distance across the Pacific from Panama to the nearest Polynesian (or South Sea) Islands is the same as the distance across the Atlantic from Lisbon (Portugal) to the Leeward Islands (West Indies)—about 2,500 miles. Hence the voyages of the Polynesians were as long as those of Columbus, and accomplished, at a much earlier date in much smaller ships.

In regard to the suggested introduction of the coco-nut into Polynesia from Southern Asia, Cook holds that this did not occur, otherwise toddy manufacture, well known in Asia from pre-historic times, but not known in Polynesia, would have been introduced also.

The greater number of varieties of coconut in the East than in America, is stated to be no argument against American origin, indicating in fact the more recent presence of the 'unimproved' wild stock in America.

Finally, Cook attributes the absence of the coconut palm in Peru to unfavourable climatic conditions (overcast skies).

His general conclusion is that the coco-nut originated in the salt-spring deserts of Columbia, where it was seen growing wild by Cieza de Leon during the middle of the sixteenth century (about 1540).

Beccari, in his paper, refutes most of these arguments. He says that recent botanical discoveries have lessened the likelihood of the Cocoineae being entirely of American origin, and cites the discovery of another true Cocoineae in South Africa (*Jubaeopsis caffra*, Beccari). He thinks *Cocos nucifera* probably assumed its present specific characters in some lands or islands existing in former times between Africa and India

The second point which Beccari makes, is the association of the 'robber crab' with the coconut palm. This crab (*Birgus latro*) is specially adapted for climbing the trees, and for grasping and breaking the nuts. Beccari thinks that this adaptation could not have been evolved independently of the coconut and presumably he assumes that the association must have started before the period of primaeval man. The robber crab does not occur in the Pacific coast of tropical America.

Beccari further maintains that Cook's evidence of the distribution of the coconut on the Atlantic side of Central America before the arrival of Europeans is unconvincing.

Beccari next brings evidence to show that the coconut fruit is capable of being dispersed by ocean currents. As an example, he refers to the natural re-stocking of the

islands in Sunda Strait, after the eruption of Krakatau Coconuts appeared without human agency.

He also brings evidence to show that the coconut palm does not always stand in need of the assistance of man for its existence and reproduction on the seashore. Observations in the Palmyra Islands are referred to in this connexion.

Lastly, Beccari maintains that the coconut palm is a tree halophyte particularly adapted to tropical seacoasts, and to oceanic dispersal.

In regard to Beccari's first point, the discovery of another member of the Cocoineae in Africa, does not alter the fact that the large majority of the members of this family are indigenous to America.

His second point, with reference to *Birgus latro* is not referred to by Cook, but Smith* states that this crab may have evolved its peculiar characteristics on palms other than the coconut.

With regard to Cook's evidence of the coconut being of very widespread distribution on the arrival of Columbus and later discoverers in America, there would appear to be some grounds for Beccari's objection. The difficulty is to be certain that these early writers knew exactly what species of palm they were referring to. As Cook points out, the coconut was not likely to have been present in large numbers, because the Indians, in pre-Columbian days, lived principally on Indian Corn: the coconut had no economic status.

There would appear to be no doubt that the coconut is capable of being disseminated by ocean currents; though whether this has ever had much influence on the dispersal of the palm, is another matter.

The question as to whether coconut trees can perpetuate themselves on the seashore indefinitely, without the aid of man, is a doubtful one. But it is a matter that could easily be decided by observation.

Beccari maintains that the coconut is a true halophyte. Presumably he means a true marine halophyte. Copeland

* Cambridge Natural History: Crustaceans.

states that the coconut is not a true halophyte: it merely tolerates salt.

There is one point which both Cook and Beccari appear to overlook, and that is the adaptation of the coconut to withstand wind. This is seen in the strength and divided nature of the leaves, the yielding trunk, the extensive root system, and the strength of the female flowers both as regards their structure and their attachment. From an agricultural standpoint, it is well-known that the coconut palm requires thorough ventilation of the leaves, as well as of the soil in which it grows. It would be interesting to know what the climatic conditions in regard to wind are, and what are the exact soil conditions in the Columbian region, which Cook considers the coconut's home.

Taking a general view of all the arguments put forward, it would seem that the question of the origin of the coconut requires further investigation, especially in regard to the botanical, archeological, and geological study of the regions held to be its home. One of two things seems likely, either that the Polynesians took the coconut to the Pacific coast of Central America, or else brought it from that coast to their own islands.

Assuming that the coconut was taken from America to Polynesia, it must have been growing fairly abundantly on the American coast, for it is not likely that the primitive Polynesians would have penetrated the Andes in search of a palm likely to be suited to the saline and exposed conditions of their tropical islands. If the coconut did not evolve under littoral conditions, how was it carried to these conditions—who brought it from Cook's 'interior valleys and plateaus of the Andes' to the seashore which turned out to be so miraculously suited to its requirements? Agricultural News, Vol. xx. No. 501. July, 1921.

COCKROACH CONTROL.—1. Traps may be used as a means of control, but cannot be relied on as a method of extermination. Sugar liquor slightly poisoned used to be a favourite trap. Poisons however are always dangerous.

2. Boric acid is a safe and economical material to use against the cockroaches, as it is non-poisonous to human beings, and yet very effective against cockroaches.

3. A mixture of equal parts of powdered borax and powdered sugar ground together is effective against cockroaches, is safe and economical, although acting slower than boric acid.

4. Cockroaches eat these substances in an effort to keep clean, and not for any possible food value.

The large cockroach which is more frequently a household pest in the West Indies may be controlled by the same means—the use of boric acid. This is freely scattered in places frequented by the cockroaches, and as they move about in search of food the boric acid adheres to their legs, bodies and antennae and in cleaning it off with their mouth-parts, they eat enough to cause their death.

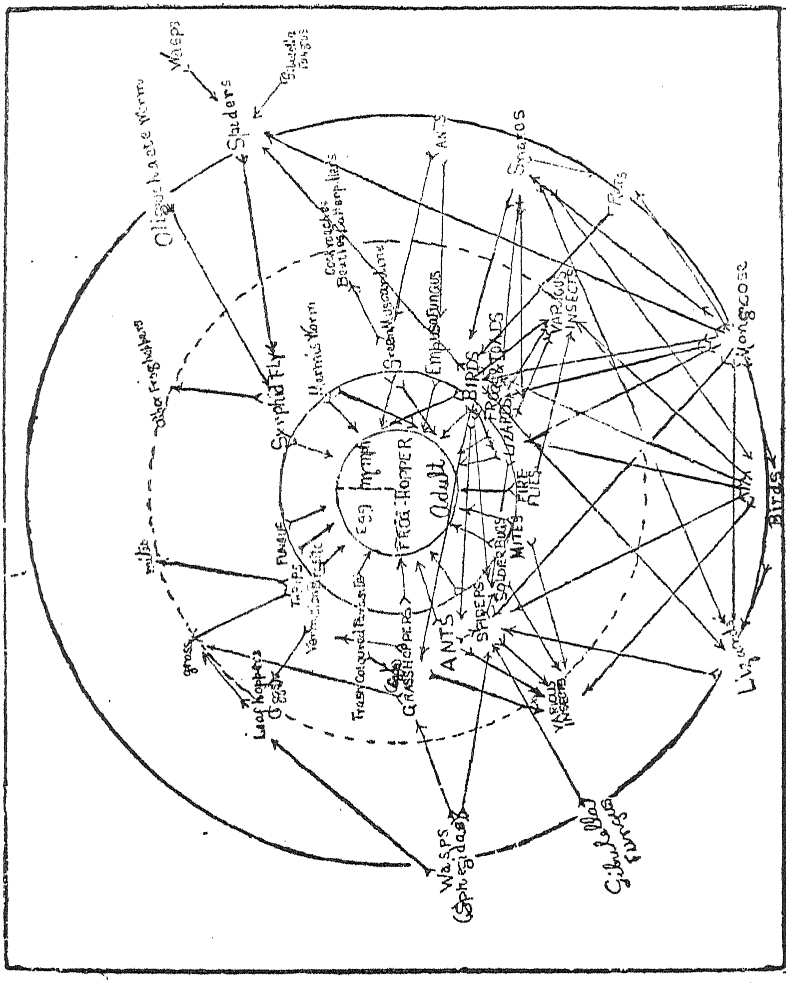
A cockroach covered with dust or dirt will, when unmolested, again begin a process of cleaning. Usually it draws first one antenna after the other slowly between the mandibles, then begins on the legs, later the abdomen, doubling up almost into a ball until it cleans itself thoroughly. Boric acid, being a very fine, light powder, readily adheres to the insect's legs and body, and must be cleaned off. The powdered borax and sugar mixture is heavier, and readily hardens if moisture is present, so is not so well distributed upon the parts of the insect's body. Hence the greater efficiency of boric acid as compared with the borax and sugar mixture.—*Journal of the Jamaica Agricultural Society.*

THE PARASITE COMPLEX.

In the memoirs of the Department of Agriculture, Trinidad and Tobago, a Report has recently been published on the Froghopper-Blight of Sugar Cane in Trinidad by C. B. Williams, M.A, F.E.S, *entomologist in charge of Froghopper investigations. It is a most exhaustive report and constitutes a history of the famous Trinidad Froghopper and of all the work that Mr. Williams himself has carried out and that of his predecessors in the same field.*

The diagram from this report which we reproduce beneath, accompanied by Mr. Williams' explanation thereof, is of very particular interest and, as he remarks, should go far in disillusioning those who are constantly advocating the introduction of parasites as an almost certain method of dealing with insect pests. The relationships which the diagram illustrates are almost human in their complexity!

EDITOR.



In the above an attempt has been made to show in diagramatic form the way in which the various parasites, hyper-parasites, and fungi connected with the froghopper are inter-related. In the centre the froghopper is shown and in the first ring round it are all its natural enemies grouped according as they feed on the egg, nymph or adult. In the outermost ring are the hyper-parasites, or enemies of the enemies, and in the intermediate ring are shown other hosts or foods of the parasites and hyper-parasites. The arrows indicate that the animal at the feathers of the arrow destroys the animal at the tip.

A careful study of this diagram will show the extraordinary complexity of the relationships and the great difficulty of deciding whether any particular animal is valuable or undesirable. Thus it will be seen that birds eat froghoppers, but they also eat lizards, which in turn eat froghoppers. The mongoose eats birds, which eat froghoppers, and as such it is undesirable. But the mongoose also eats rats, which eat birds, which eat lizards, which eat spiders, which eat syrphid flies, which eat froghoppers. What conclusion can be drawn from this?

It is hoped that an examination of this diagram will disillusion those who speak of the "Introduction of New Enemies" as if it were a remedy the obviousness of which was only exceeded by its simplicity and certainty of success.

MEETING OF THE NEW BOARD OF AGRICULTURE.

A meeting of the Board of Agriculture under the new Ordinance of 1920 was held at the offices of the Board, Broad Street, on Friday, August 5th, 1921. His Excellency the Officer Administering the Government, Hon. C. Clementi, C.M.G. (President), presided. Also present were

Sir John Harrison, C.M.G (Chairman), G. E. Bodkin (Deputy Chairman), C. Shankland, H. L. Humphrys, B. Gainfort, J. Crabtree, S. H. Bayley, E. Beckett, A. Seton Milne, T. Earle, R. Ward, Rev. E. R. O. Robertson and E.M. Peterkin (Secretary to the Board)

By-Laws and Regulations.

The Chairman laid on the table the Board of Agriculture Ordinance 1920, and reported the appointment of members of the Board. The Registration of Mr D. H. Rylands as a Veterinary Surgeon was also notified.

By-laws Relating to the Botanic Gardens and D'Urban Park, traffic in the Botanic Gardens, Public Gardens, New Amsterdam, subsidiary stations of the Board and the Promenade, and Company Path Gardens were considered and adopted.

Regulations of the Board were adopted with respect to the affiliation of District Agricultural and Farming Associations. The Secretary, The Library. The Editor of the Journal. The Executive Committee. The Exhibitions Committee. The Subsidiary Products Committee. The live Stock Committee. The Veterinary Committee. The Contagious Diseases (Animals) Committee. The Plant Diseases and Pests Committee. The Destructive Pests Committee, The Government Farms Committee. The Ornamental Gardens Committee. The Stallions Control Committee. Rules governing Services. The D'Urban Park—agistment of horses and sheep and cutting of grass. Plant diseases and pests prevention—sugar canes. Plant diseases and pests—Para Rubber. Improvement of breed and prevention of contagious diseases (animals)—notification of illness. Plant diseases and pests (prevention)—inspectors.

Improvement of breed and prevention of contagious diseases (animals)—regulating movement of animals out of infected area. Improvement of breed and prevention of contagious diseases (animals)—persons to inoculate and bleed animals. Order prohibiting importation of dogs.

Agricultural Census, 1920.

The Chairman in laying on the table a statement of the results of the agricultural census for 1919 and 1920 remarked that there was a falling off in all agricultural products in 1920. He deprecated the growing habit among rice cultivators of planting too late. Owing to this habit there were 9,000 acres less under rice cultivation in the colony than the year before. The rice growers not only missed the season but ran the risk of failure to reap during the rainy season in December.

A considerable discussion then took place relative to the correct period at which to plant rice. The consensus of opinion appeared to be that where an assured water supply is present, early planting should be enforced but in other districts where the rice farmers had to trust to the weather for the necessary supply of water the farmers often had to wait for a seasonable time to sow.

Results of the Agricultural Census for 1919 and 1920.

The following are the returns laid on the table by the Chairman.

Crops of	*1919.*	*1920.*
	Acres.	Acres.
Sugar Cane ...	70,876	59,532
Rice Total Acreage	61,405	54,433
,, Spring Crop...	12,820	14,023
,, Autumn ,, ...	61,405	51,718
,, Total acreage reaped	74,225	65,741
Coconuts ...	27,518	24,425
Cacao	2,147	1,846
Coffee	5,125	5,051
Rubber	4,042	2,813
Limes	1,325	1,054
Ground Provisions...	18,192	15,686
Maize	no returns	1,147

LIVE STOCK.

Horses, Coastlands	890	941
,, Hinterlands (estimated)	300	300
Mules, Coastlands	2,360	2,105
Donkeys	6,985	7,106
Cattle, Coastlands	79,614	85,938
,, Hinterland	26,000	26 000
,, Total ...	105,614	111,938
Buffaloes	193	174
Goats	10,920	11,250
Sheep	20,110	22,202
Swine	15,580	17,401

BRITISH GUIANA.

RICE CROPS, 1920.

Bags of 140lbs Padi.

County of Berbice.	*Spring Crop.*	*Autumn Crop*
Corentyne ...	4.5	Nil
Berbice and Canje River District ...	16.0	15.9
West Berbice ...	.9	2.9
County of Demerara.		
Mahaica and Mahaicony District ...	—	15.0
East Coast ...	.9	19.7
Demerara River District ...	8.8	9.7
West Demerara ...	14.0	16.0
County of Essequibo.		
Essequibo River Islands ...	13.5	19.2
Essequibo Mainland	12.3	16.7
Pomeroon ...	—	11.1

Whole Colony.	*Per acre reaped.*
Spring Crop	9.7 bags of 140 lbs Padi.
Autumn ,,	11.2 ,, ,, ,, ,,
Both Crops	10.0 ,, ,, ,, ,,

More Important Cattle and Rice Districts.

Districts	*Years.*	*Cattle (head.)*	*(Rice acres)*
County of Berbice.	1915	24,991	14,179
	1916	21,942	18,926
	1917	26,717	17,266
West Berbice & Abary District.	1918	25,556	16,881
	1919	23,303	23,361
	1920	24,046	23,444
Berbice and Canje Districts.	1915	11,318	6,506
	1916	12,261	6,055
	1917	14,962	6,581
	1918	12,733	6,920
	1919	13,902	9,852
	1920	17,506	6,597
Berbice Corentyne District.	1915	24,431	8,743
	1916	27,750	9,841
	1917	18,607	10,000
	1918	12,646	11,963
	1919	12,812	9,504
	1920	13,348	2,720
County of Demerara.	1915	11,207	5,374
	1916	9,590	5,491
	1917	9,661	6,143
	1918	10,576	7,127
Mahaica & E. Demerara	1919	11,166	4,573
	1920	10,267	11,394

Less Important Cattle and Rice Districts.

Districts.	*Years.*	*Cattle (head)*	*Rice (acres.)*
	1915	5,562	4,936
County of Berbice	1916	5,895	5,050
	1917	6,722	6,061
	1918	5,269	7,922
	1919	5,419	4,495
West Demerara	1920	7,114	4,530

East Bank Demerara River	1915	1,739	739
	1916	1,536	3,173
	1917	1,536	3,311
	1918	1,736	1,035
	1919	1,615	833
	1920	1,256	896
County of Essequibo.	1915	5,532	6,041
	1916	6,091	4,466
	1917	6,132	4,320
	1918	5,743	5,025
East and West Essequibo.	1919	7,057	4,819
	1920	7,396	4,334
Essequibo River Islands	1915	3,068	3,928
	1916	3,410	4,072
	1917	2,913	4,073
	1918	2,392	3,527
	1919	3,161	3,471
	1920	3,695	3,783

Decrease in Rice and Cattle.

The Chairman remarked that the production of rice per acre had fallen off 60 per cent. last year. The number of cattle and horses had also fallen off. The Veterinary Surgeon in replying to a query on this matter stated that he could give no adequate explanation of the decrease. There had been no recent epidemic but severe droughts had been experienced which had proved in some instances disastrous to animals. Some question was raised as to the accuracy of the returns furnished.

Exportation of Sheep, Goats and Swine.

His Excellency asked for an expression of opinion from the Board concerning the exportation of sheep, goats and swine. The Chairman remarked that in 1915 an outbreak of swine fever in the Buxton area had caused a loss of 30 per cent. of the normal number of pigs in the Colony and their exportation to Dutch Guiana had consequently to be stopped.

The Board eventually agreed that the exportation of these animals might be allowed.

Agricultural Shows.

A number of petitions for grants of money, to various Agricultural Societies, to hold Agricultural Shows were refused by the Board on the grounds of economy and their apparent uselessness as a means of helping the farmers. A sum of $1,500 was allocated to the Live Stock Committee for the purchase of Live Stock; a number of applications from Agricultural Societies for affiliation were considered and a number of Quarantine Orders were revoked.

Dumb Rabies.

The Government Veterinary Surgeon gave a statement concerning the difference between dumb Rabies and sunstroke.

His Excellency in terminating the proceedings said that the Board should record its gratification that the Chairman had been Knighted by His Majesty the King.

GENERAL PRACTICES IN YAM GROWING.

The kinds of yams commonly grown in Porto Rico are not particularly sensitive to the type of soil in which they grow, provided the weather conditions are favourable and the proper cultural practice is followed. They are most prolific, however, in a deep, fertile clay and give poorest yields in light, sandy soils. Some varieties make good yields when grown in heavy sandy loams. Other varieties yield very well in the heaviest clays where the ridges are sufficiently high to enable

the plant to develop a good root system. Compacted and wet soil hinders the growth of the plant and prevent normal root development. Where ridge planting is practised the roots make a normal growth above the zone of wet soil.

In all frost-free countries yams may be planted at any time of the year, though not always profitably in a long rainy season, nor where there is a protracted drought such as sometimes occurs in Porto Rico and other Islands of the West Indies. During the season of rains the heavy wet soil tends to hasten any decay that has started in the seed yams, and too frequent rains retard and stunt the growth of the young plants. On the other hand, a long dry season, if it is followed by drought, is even more detrimental to them. Young plants set out in the dry season may not obtain sufficient nutriment to continue growth after the supply in the seed tuber is consumed. The best time to plant in western and southern Porto Rico, and probably through this island, is after the usual winter drought—that is, from late February to April—when the soil has been left in good condition for planting by the spring rains. Normal growth is then assured. Fall plantings should be made after the time of most frequent rains, but while they are still sufficiently abundant to cause a thrifty growth of the young plants. This particular period is during the last of November in Mayaguez, where the seasons are well defined.

The crop which is planted in the spring matures late in the fall and winter, and may be left in the ground during the dry winter without fear of deterioration. This crop is available for table use through a long period or for disposal at a satisfactory price, depending upon the demands of the local market. Yams intended for the succeeding crop may be left in the soil until planting time the following spring. In this way good seed may be preserved from decay. Clean seed is an important factor in establishing a good stand of new plants. Should a drought follow planting, the root sections, if they are

free from decay, will remain in good condition for many weeds, owing to the thick corky covering of the yam which enables the seed pieces to retain for a long time sufficient moisture for the growth of the plant.

The yam, though very resistant to severe drought, requires a heavy rainfall for its best production. The plant does not have an extensive root system, nor roots that work deep into the earth, yet it secures sufficient moisture to carry it through long rainless periods. This is observed along the southern and western parts of Porto Rico, where the vines make a moderate growth and show no effect from a drought which injures other vegetation.

In preparing the land for planting care should be taken to bring the soil into good mechanical condition. Substantial ridges or hills should be made to protect against excessive soil moisture and to secure good aeration of the soil. An excess of water in the soil invariably results in a crop of poorly developed roots. The deep-rooted varieties when grown in heavy unloosened soil are rather angular and irregular in shape, and the production is small.

To avoid such results, ridges of loose earth and vegetable matter should be constructed from 1 to 1½ feet high, depending upon the locality and the subsoil drainage. These ridges should be made by plowing the land deeply and thoroughly and by opening a wide furrow over which the ridge is to be made. In this furrow a few inches of dead vegetable matter should be placed and covered with 2 or 3 inches of earth. This should be followed by another layer of vegetable matter, the layering being continued thus until the ridge is finished. As the vegetable matter decays it causes a settling of the earth. The beds should, therefore, be made a few inches higher than otherwise would be necessary for the growth of the plants.

These ridges may be cheaply constructed with a plow, the only hand labour needed being in the application of the vegetable matter and the final rounding up of the ridge with holes. The layers of manure or other vegetable

matter in the ridges insure a loose, well-aerated medium for the development of the roots, and seem to be required for their best development. The ridges do not need to be large in sand or sandy loam unless the sub-drainage causes poor aeration of the strata occupied by the roots. In these soils the humus-providing material should never be omitted.

When seed is scarce, either crowns or entire small tubers may be successfully used, or a cross-section of a slender, cylindrical root may be planted. The crown or upper part of the root is the most satisfactory part for planting, because it is less desirable as food and better able to withstand exposure, bruises, or unfavourable weather longer after planting than other parts. When it is profitable to market the crop before the proper time to plant a new crop, the crowns may be left in the soil for a number of weeks after the remainder of the root has been removed. This can be done by removing from one side of the plant all the soil until the entire edible root is exposed, dividing the root at the desirable point, and removing the lower section. Care should be exercised to avoid injuring any of the feeding roots, which are spread laterally in all directions from the crown. The hole from which the earth is removed should be immediately refilled so that the plant can continue to grow and develop strong buds. Each plant has from two to four buds or eyes. The lower part of the yam has a much higher water content than the crown and consequently it is more susceptible to injury and decay than the upper part. It is also slower in starting into growth than the upper part, and should not be used unless seed yams are scarce.

The experiment station found that a good percentage of sections (taken from the largest roots) sprouted when placed in a cool, shaded place, and made a normal growth when transferred to the field. The crown and part just below usually send out from two to four sprouts promptly, and may be divided longitudinally with good results provided the piece of the root is large enough to supply nourishment for the young plant.

To secure heavy yields, seed pieces of good size should be planted. One to 2 ounce pieces are often planted in Porto Rico, but pieces weighing from 4 to 5 ounces should be used. Tests made at the station with different sized seed pieces of common varieties and with entire tubers of some of the small-rooted varieties showed that a good gain in yield was made by using large rather than small seed pieces.

Treatment of Seed Roots.

Poor stands of plants are usually caused by sections of the roots decaying before the vine growth starts. The following treatments were given a number of seed pieces to test their efficacy in preventing the entrance of decay through the cut surface of seed pieces.

The cut surfaces of one lot were covered with air-slaked lime; those of another lot were exposed to the sun for one day; two lots were treated with Bordeaux mixture, one as soon as the roots were cut and the other after drying in the sun for 10 hours. An untreated lot was placed in the storage house as soon as it was cut.

A small-rooted type of the Potato variety and a large-rooted kind of the St Vincent were used in this test. The yams were harvested 15 days before treatment, and after treatment were stored in a room having a high humidity and temperature of probably 80° F. Such conditions favour the rapid decay of the roots.

Two weeks after the treatment was applied the roots were examined. It was found that where the lime had been applied 40 per cent. of the pieces were decayed, although none of them was entirely destroyed. Where Bordeaux mixture was applied to freshly cut surfaces only 16 per cent. of the pieces showed decay, and all could be planted. The application of Bordeaux mixture to the lot that had been previously dried resulted in little improvement over the check. In the untreated lot more than three-fourths of the pieces were considerably impaired and a few were entirely consumed by disease,

while only 12 per cent. were in normal condition. In all cases a percentage of the decay on the cut surfaces developed from bruises on other parts of the roots, and in some instances from infections received after the roots were cut. The Potato variety was slightly less injured than the St. Vincent.

Distance apart to Plant.

The distance between the seed yams in planting depends much upon the normal growth of the variety. One foot apart in the ridges is sufficient for varieties producing small roots, but the larger rooted kinds require a distance of 1 to 2 feet. In Porto Rico it is the practice to plant much farther apart than this, sometimes twice the distance. This is hardly wise, because a given area will produce much more when close planting is practised. The cost will be lower, too, since the only cultivation required after planting is occasional weeding and maintaining well-formed ridges. The expense involved in cultivation consists mainly in plowing the land, securing suitable vegetable matter or manure for the ridges, building the ridges, and placing poles for the support of the vines. Any decrease in area prepared for planting results in a proportional decrease in expenses, equally good preparation being necessary for planting at any distance. Where hill planting is practised the hills should be from 3 to 4 feet apart each way, depending upon the type of soil. The wider distance is necessary in heavy soils because the hills must be made higher than in more open soil to insure good aeration and drainage. The closest planting will be found convenient in light soils. The seed should be covered with 2 or 3 inches of earth to prevent it from drying in case drought follows, or from being washed out by heavy rains.

Tests of Vine Pruning.

To test the effect of pruning on yams, plantings were made of Guinea and Potato varieties, because they are representative of large and small rooted kinds. The ridges for planting were made in the usual way and in

soil that was well adapted to the crop. The plants made thrifty growth and were pruned back each week, the Guinea to 6 feet and the Potato variety in one plat to 2 feet, in another to 4 feet, in a third to 6 feet. Plats of each variety were left unpruned for checks. The vines of the Potato variety continued thrifty through the season, but the pruned vines of the Guinea variety lost some of their rich colour before fall and became dry several weeks earlier than the check plant. The harvest from the pruned plants of the variety Guinea was only 46 per cent. of the yield obtained from the check plat. The yield from the potato variety was 29 per cent. from the vines pruned to 2 feet, and 46 per cent. from those pruned to 4 feet, while the yield from plants pruned to 6 feet was 68 per cent. of that obtained from the check plat.

This clearly shows that the vines should not be pruned or injured if the best results are expected. Where the vine supports were insufficient or allowed to blow over and were not promptly replaced, there was a marked decrease from the normal yield. Vines not provided with supports, but allowed to creep over the ground, made very poor growth and give low yields of roots.

Harvesting.

Such implements as mattocks, heavy forks, and spades are required for harvesting yams, because the earth must be removed to the depth of the roots. The large roots fit firmly in the soil and it requires great care to remove them without injuring them. They will be bruised if pulled or pried out before the soil around them is well loosened or removed. The process of digging deep-rooted types in heavy soils is difficult in dry weather, because the roots are often enlarged near the lower end and are easily injured during removal from the hard soil. Roots of all varieties of yams are subject to rapid decay if they are bruised or the skin is broken. When bruised to any depth they soon become unfit for use. The yam,

like the potato, is used while it is fresh, and every precaution should be taken to keep it from decaying, so that the entire crop can be utilized.—*Bulletin No. 27. Porto Rico Agricultural Experiment Station.*

TANNING SKINS.

Goat skins make beautiful rugs, and the tanning is not nearly so complicated a process as one would imagine. First, make a strong lather with hot water and soap; let it be cold and then wash the skin in it, carefully squeezing out all the dirt from the wool; after which wash it in cold water until all the soap is rinsed out, changing the water until the last one is clear. Then put the skin in a tub and pour over it two gallons of hot water in which has been dissolved a pound each of salt and alum. See that the skin is completely covered, and let it soak for twelve hours. Drain it well then, and stretch it carefully on a board to dry, stretching it several times while drying. Before it is quite dry sprinkle on the flesh side a mixture of one ounce each of finely pulverized alum and saltpeter, rubbing it in well. Let the skin remain a day or two, and if the hair does not seem to be firm, rub again with alum; fold the flesh side together and hang in the shade two or three days, turning over each day until dry. Then scrape the flesh side thoroughly with a blunt knife and rub with pumice-stone until it is clean, and the skin will be ready for use.—*Journal of the Jamaica Agricultural Society.*

DEMERARA-BERBICE SAVANNAHS.

(Extracts from Robert H. Schomburgk's "British Guiana 1840.")

The sand-hills are followed by savannahs, which generally extend to the first rocky belt, and are sometimes interspersed with woods and rivulets. They are most extensive between the rivers Demerara and Berbice; they are also frequent between the latter river and the Coren-

tyne; but these must not be confused with those of the Rupununi, which are sterile The former are clothed with nutritious and wholesome grasses, and in consequence of the number of springs and brooks, and the thickets of wood with which they are interspersed, it appears as if Nature herself had pointed them out for the pasture-ground of thousands of cattle and horses. Those between the rivers Berbice and Demerara occupy upwards of three thousand square miles, and the favourable circumstance that they are plentifully watered by tributaries of the Demerara and Berbice, and interrupted by woodland to afford shade during the heat of the day, enhances their value as grazing-grounds.

I alluded in former remarks to the fitness of the extensive savannahs between the rivers Berbice and Demerara, for grazing-grounds, and that they are much superior for that purpose to those of the Rupununi. The climate in these regions is uncommonly healthy, and the country so well watered by springs and rivulets, that the great want of water which exists in the savannahs of the Rupununi, and which is such an obstacle that I fear they will never be inhabited by Europeans or their offspring, is here entirely set aside. If, therefore, enterprising colonists should cultivate pasturing-grounds, and stock them with cattle from the savannahs of the Rio Branco, fresh beef might be had at an equally cheap rate as in the United States: it will then be in the power of the peasantry of British Guiana to provide themselves with fresh meat at a price which bears a relative value to their wages.

AGRICULTURE *Versus* MALARIA.

By E. P. Minett, M.D., D.P.H., D.T.M. and H.,
Government Medical Officer of Health.

A perusal of the reports of the various anti-malarial commissions established in various parts of the world throws much light on the great part played by the agriculturist in the fight against malaria. The well known "Bund" system used by Bentley in India is an example of what can be done to reduce malaria by means of properly controlled and applied agricultural methods of fighting the mosquito. The "bund" system consists in converting low-lying portions of land into ridges or beds somewhat in the same way as is done on sugar estates, but the beds are wider; the high beds are then used for cultivation and the water remaining in the channels between is kept comparatively free from mosquito larvae simply by keeping the channels free from vegetation and by strict attention to the edges. The mosquito larvae being thus deprived of shelter are left to be dealt with by their natural enemies. It is a well known fact that mosquito larvae are very difficult to find in ponds, trenches or streams where no vegetation exists. In Salonika it is remarkable that the small streams are free from vegetation and larvae very difficult to find except at one portion of the year during the spring, when they are overgrown with a small filimentous aquatic plant called "spirogyra." This plant appears at the beginning of the mosquito season and is the natural food of the larvae. In streams where this vegetable growth was systematically removed, larvae were very rarely detected and adult mosquitoes uncommon after the bushes which form their natural shelter had been removed.

Much controversy has arisen over rice cultivation and interesting articles have been written in the "Rice Journal" and "Southern Farmer" in America. A large number of investigations were carried out and it was

found that some rice fields do not produce anopheles at all, whilst other rice fields produce them in moderate or large numbers, but seepage and drainage water incident to rice culture largely increase these numbers. This is borne out by our own investigations in this colony, as I think it is generally admitted that, although anopheles mosquitoes are undoubtedly found in rice fields, still they are much more abundant in the drainage canals and swamps surrounding the rice fields than in the fields themselves. This is what would be expected as the mosquito larvae do not thrive in the open clear water of the rice fields because they have no shelter from their natural enemies.

The writer has always held that undoubtedly rice cultivation is not a healthy one from a malaria point of view, still rice fields are preferable from a health point of view to stagnant swamps, borrow pits and overgrown neglected drainage trenches,—firstly, because rice fields are far less suitable breeding places for mosquitoes, and secondly, because rice fields are valuable from an economic and food standpoint and they mean an abundant supply of the staple diet of the labouring classes. Whereas swamps, &c., are much more suitable breeding places and are of no economic value whatever.

The preliminary report of the Anti-Malarial Commission in Egypt states: "The largest breeding places such as marshes, borrow pits and birkas (ponds) can only be dealt with by filling them in." To attempt to fill in the vast areas of marshy land in British Guiana is a hopeless task, but this land could be more widely taken up for rice cultivation and after a few years other crops can be substituted when the drainage has been improved and the surface gradually raised by successive rice crops.

The Egyptian report states: " Rice, it is understood, cannot be grown under conditions that will not produce mosquitoes. It is, however, a crop that is generally grown on land unsuitable for other cultivation, and in Egypt,

when the rice fields have been properly drained, it will to a great extent yield automatically to more valuable crops such as cotton."

If swamps and land unsuitable for cultivation can be made suitable by means of rice cultivation as preliminary crops in Egypt, I see no reason why it cannot be carried out successfully here.

In some parts of the world where rice is grown largely, very great attention is paid to the drainage and irrigation canals as being more important from a malaria point of view than the rice fields themselves. The banks of the larger channels and the whole bed of the smaller drains are sprayed with crude petroleum oil; they are then lightly sprayed with petrol or refined petroleum and fired at once. This treatment has been found very efficient in preventing mosquito breeding in Trinidad. It has occasionally been used here on a small scale, but not on a large enough scale, owing to the expense to prove its efficiency. Every village lot proprietor can become an anti-malaria enthusiast on a small scale with very little trouble and very great benefit to his own and his family's health.

Low-lying swampy ground can be raised and converted into valuable cultivation land by the very simple process of digging out a few inches of the low-lying swampy patch of land. Then fill in the hollow with house and garden refuse until it reaches above the level of the surrounding land, finally spread the earth originally excavated evenly over the surface of the rubbish. In a few weeks it will settle down and provide a most valuable provision bed where previously only a dangerous mosquito breeding swamp existed.

The above is a piece of practical hygiene which might very well be carried out by school children in the school yard as an agricultural lesson.

Malaria disappears before good agriculture and sanitation.

EXPORTS OF AGRICULTURAL AND FOREST PRODUCTS.

Below will be found a list of the Agricultural and Forest Products of the Colony exported during the first nine months of 1921. The corresponding figures for the two previous and the average for the four years previous to that are added for convenience of comparison.

Product.	*Average 1915-18.*	*1919.*	*1920.*	*1921.*
Sugar, tons ...	63,382	43,583	48,442	59,283
Rum, gallons ...	2,705,790	3,438,593	1,183,175	1,799,349
Molasses, gallons ...	28,831	171,247	100	204
Cattle-food (Molascuit tons)	1,394	1,112	953	1,055
Cacao, cwts. ...	224	85	207	None
Citrate of Lime, cwts.	165	306	206	286
Lime Juice, gals. ...	8,286	6,663	2,641	3,850
Essential Oil of Limes, gals.	149	291	236	463
Coconuts, thousands	1,255	3,040	2,139	1,999
Copra, cwts. ...	1,575	1,602	296	654
Coffee, cwts. ...	2,702	7,933	3,554	684
Kola-nuts, cwts. ...	12	None	9	None
Rice, tons ...	9,498	3,158	8,084	1,095
Ricemeal, tons ...	172	None	None	None
Cattle, head ...	498	1	4	None
Hides, No. ...	2,547	5,369	5,166	11,615
Pigs, No. ...	558	None	None	47
Sheep, head ...	15	None	66	26
Balata, cwts. ...	6,672	4,999	7,740	4,290
Charcoal, bags ...	37,449	33,020	35,749	39,174
Firewood, Wallaba, etc., tons ...	6,563	5,939	3,977	4,684
Gums, lbs. ...	264	2,001	3,361	8,792
Lumber, cub. ft. ...	157,969	179,237	207,476	141,038
Railway sleepers, No.	10,476	2,008	10,707	5,512
Rubber, cwts. ...	91	79	134	14
Shingles, thousands	1,840	1,932	1,722	1,616
Timber, cub. ft. ...	63,839	98,303	57,088	114,413
Coconut Oil, gals. ...	18,545	6,371	12,176	11,326

ATTENDANCES AT THE DISTRICT GARDENS

Year.	Bourda.	Belfield, E. Coast.	Stanleytown, New Amsterdam.	Suddie, Essequibo.	Den Amstel.	Houston, E. Bank.	Wakenaam.	Total Attendances.
1912 ...	5,514	4,395	3,302	2,100	2,544	2,156	718	21,729
1913 ...	5,156	4,535	2,519	3,399	2,568	1,836	1,319	21,332
1914 ...	4,243	3,869	2,443	3,025	1,791	1,653	1,533	18,577
1915 ...	1,123	1,006	769	59	503	339	401	4,200
1916 ...	4,705	1,161	1,510	225	623	2,251	1,297	12,026
1917 ...	4,991	2,820	1,366	3,297	1,186	2,564	1,663	17,886
1918 ...	4,834	3,081	1,653	2,671	2,162	2,790	2,067	19,258
1919 ...	4,769	2,425	1,582	2,798	1,851	2,480	1,556	17,461
1920 ...	6,285	2,312	1,665	2,525	2,532	3,228	2,148	20,695
1921 ...								
1st Quarter	1,761	639	502	307	673	829	490	5,201
2nd Quarter	1,790	554	410	1,408	549	812	430	5,993
3rd Quarter	1,210	289	350	405	315	499	306	3,374

Meteorological Data—July to September, 1921.

1920 Months	Rain-fall.	NUMBER OF DAYS OF RAIN						Evapo-ration.	Air Temperature and Humidity.			
									Air Temp.			
	Inches.	Under ·10 Inches.	·10 to ·50 Inches	·50 to 1.00 Inch	1.00 to 2.00 Inches	Above 2.00 Inches	Total days.	Inches	Maximum	Minimum.	Mean	Humidity.
Botanic Gardens.												
July ...	12.73	3	11	2	7	...	23	4.15	84.7	74.0	79.3	82.6
August	3.52	7	6	2	...	...	15	5.44	86.0	75.6	80.8	78.3
Sept. ...	3.42	5	7	2	...	...	14	5.02	86.8	76.1	81.4	79.8
Totals & Means.	19.67	15	24	6	7	...	52	14.61	85.8	75.2	80.5	80.2
Berbice Gardens.												
July ...	11.71	1	8	6	4	...	19	...	85.3	75.2	80.2	82.8
August	5.34	...	10	2	1	...	13	...	85.9	75.5	80.7	74.8
Sept. ...	3.34	1	6	1	1	...	9	...	87.6	76.0	81.8	80.3
Totals & Means.	20.39	2	24	9	6	...	41	...	86.2	75.5	80 9	79.3
Suddie.												
July ...	11.05	1	7	6	4	...	18			87.9	72.8	80.3
August	6.10	5	2	3	2	...	12			87.8	72.7	80.2
Sept. ...	4.15	2	8	1	1	...	12			87.8	72.7	80.2
Totals & Means.	21.30	8	17	10	7	...	42			87.8	72.7	80.2
Mora-whanna												
July ...	18.73	1	7	5	4	3	20	...	...	...	...	...
August	13.49	7	8	4	4	1	24	...	...	...	...	...
Sept. ...	16.29	3	2	4	4	3	16	...	...	...	...	...
Totals ...	48.51	11	17	13	12	7	60	...	...	...	...	...

NOTICE TO AGRICULTURISTS.

POST OFFICE SAVINGS BANK.

A cash balance is a hall mark of the good farmer; it is also an essential of progress. It means, also, independence; for a well established balance in the Savings Bank does away with the discomforts and dangers of obtaining credit in order to plant and reap one's crops and, later, the attendant evil of being compelled to sell the produce at a disadvantage. Remember that no profits are made by the Government on the moneys deposited in the Post Office Savings Bank as this Bank is intended solely as an aid in the practice of economy and thrift also—

Deposits are absolutely safe.

Any person may open an account.

A married woman may deposit in her own name.

A minor at the age of . 4 may do so also.

Interest is paid on deposits up to $2,500. The rate of interest at present is 3 per cent.

A depositor may withdraw or deposit money at any Post Office.

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JOURNAL

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VOL. XV. JANUARY, 1922. No. 1.

THE HOUSE FLY.

Yet another link has been forged to the chain of evidence which attaches to the house fly a wide world reputation of complete undesirability.

A series of carefully performed experiments carried out in Texas by the U.S. Bureau of Entomology, the salient conclusions and less technical features of which we have embodied in this number, demonstrate that this insect is capable, under rural conditions, of flying slightly over 13 miles, has marked migratory habits and can cover long distances in a comparatively short space of time.

We need hardly discuss here the well known relationship which exists between the house fly and certain human diseases, a relationship from which British Guiana suffers—past, present and future. Like our other intimate, domestic insect acquaintance—the mosquito to wit—its presence should not be tolerated.

Sanitation—like charity—can begin at home. Well-kept premises, a yard free from fly breeding conditions, should be a source of pride to every house holder and an example to others.

How often do we see such things? Too often the refreshing spectacle of a spick and span yard is totally marred by the presence of a stable or pen accompanied by a large manure heap—the home of countless generations of house flies.

Admittedly it is easy and inexpensive to criticise and an undertaking of a sanitary nature on our premises such as is indicated above is seldom either, but the profits are accumulative and, after all, health is the first wealth and any practice having this end in view should receive the best of our attention.

MALARIA STATISTICS.

It may be of interest to the reader to have the following statistics, furnished by Dr. Angus Macdonald, M.D., D.P.H., D.T.M., showing the effect of anti-malarial measures on the reduction of the disease in Kingston, Jamaica.

Year.	1910	1911	1912
Malaria deaths.	126	72	16
Malaria notifications (General Hospital)	723	349	81
	No specific anti-malaria measures undertaken.	Specific measures of prevention taken.	Measures of prevention maintained.

Dr. Macdonald states that the results of 1911 were obtained by the same subordinate sanitary staff that existed in 1910. The progress is due to their work having been specifically directed to the prevention of malaria as well as to other and more general matters of public health.

Many of the larger estates in Jamaica are now tackling the malaria problem as part of the estate routine and expenditure.

DISPERSION OF FLIES BY FLIGHT.

The following extracts from a paper on the above subject taken from the Journal of Agricultural Research give some very interesting results and are also valuable from the point of view of public health.—(Editor.)*

A definite knowledge of the means of dissemination of various species of economic insects is of much importance in control or eradicative undertakings. Undoubtedly the spread of injurious forms by artificial means is in general of most pronounced importance. With free-flying species, however, natural dispersion deserves careful consideration. This is particularly true of the various species of flies which directly affect man and animals. The accumulation of data on the possibilities of flight of various injurious species of flies should aid economic work in several ways.

1. It should help in the study of the spread of fly-borne diseases, either in large districts or locally.

2. It should make possible the proper location of dumps, incinerators, hog-feeding stations, and other favourable breeding grounds so that the menace to towns, cities, military camps, etc., will be reduced to a minimum.

3. In control work in restricted districts or about individual plants it should help in determining the extent to which fly-breeding grounds in the neighbourhood affect these undertakings.

4. In the prosecution of large-scale control work against certain species on farms or ranges, it should show how widespread must be the effort if marked results are to be accomplished.

5. It should make it possible to determine whether control campaigns are accumulative from year to year in their effect, or whether, owing to extensive migration, the results are effective only during one year or one period.

* By F. C. Bishopp, Entomologist, and E. W. Lakke, Entomological Assistant, Investigations of Insects Affecting the Health of Man and Animals, Bureau of Entomology, United States Department of Agriculture.

With a view to securing some definite facts as to the tendencies and possibilities of dispersion under rural conditions, a series of tests with injurious species was carried out in Northern Texas during the summers of 1916 and 1918.

METHOD OF CATCHING, MARKING, AND LIBERATING FLIES

Practically the same method of handling the flies was used throughout the several tests conducted. The supply was secured by baiting large conical flytraps with "gut slime," a packing house by-product. These traps were left in operation from a few hours up to 24 hours; then a screen cylinder was placed on top of the flytrap. The cover of the trap was removed, and the flies were agitated so that they would pass upward into the cylinder, which was first supplied with a number of green branches from trees. Few of the weaker, disabled flies would pass upward into the cylinders. When several thousand had passed into the cylinder a cheesecloth was placed over the lower end of it. All the flies were captured in Dallas or Fort Worth at the packing houses and were then transported to the point of liberation. The time from placing the flies in the cylinders until they were liberated ranged from 1 to 2 hours.

When the point of liberation was reached the cylinders were slipped into a canvas bag one at a time and from 1 to 2 ounces of finely powdered red chalk or paint pigment were introduced into the cage, which was inverted several times. The top was then removed, and the flies were allowed to escape. All flies were then shaken from the cages.

The number and percentage of the different species of flies released were estimated by looking into the screened cylinders. While it is realized that this estimate is very rough, the writers' experience in handling great numbers of flies in traps has added to the reliability of the estimates. In one instance the flies in one trap were killed, and the proportion of species and sex was determined by actual count.

When the flies emerged from the cage they were all distinctly covered with the chalk, the majority of them being

brilliant red. In one instance yellow chalk was used and in another the flies were sprayed with rosalic acid, but the yellow colour was not so readily distinguished in the mass of flies caught in the recovery traps, and not a single fly sprayed with rosalic acid was identified when an alkaline solution was applied to the specimens taken in the recovery traps. In a few of the liberations a red paint pigment was used, and this also seemed fairly satisfactory.

In every case there was a considerable mortality among the flies placed in the cages, but it is believed that this was caused more by the heat while the specimens were being transported to the place of liberation than by the application of the marking agent. That there may have been some deleterious effect from the application of the chalk dust cannot be denied, but the fact that some marked specimens were recovered 17 days after application indicates that the method of marking was not highly injurious.

ACTION OF FLIES WHEN LIBERATED.

All liberations were made on the ground in open fields. In every instance a considerable number of the flies were observed to take to the air immediately, some passing upward to a considerable height. They seemed to fly freely in all directions, but there seemed to be more going with the wind or at right angles to it than in other directions. A large number settled on the grass near by, and many of these were observed to be preening themselves in a contented way. In experiments where trees were near at hand large numbers were observed to settle on the leaves. Many flies exhibited great thirst, as was shown by efforts to procure moisture from the leaves and perspiration on our bodies. They persistently stuck to our clothing, hands, and faces, and, although the conveyance used was always left some distance from the point of liberation, a few flies were in every instance observed to be about the vehicle when the start away from the point was made. The flies were at first driven off, and after a short distance had been travelled all of those about the vehicle were killed. A second and sometimes a third examination were made to make sure that no coloured specimens were following.

RECOVERY AND IDENTIFICATION OF FLIES.

In order to determine the distance of dissemination, conical traps 18 inches in diameter baited with "gut sline" were set at measured distances in different directions from the point of liberation. The flies collected in these recovery traps were killed at daily intervals as nearly as possible, and the mass of flies was carefully gone over for coloured specimens. In most instances the coloured flies could be identified with the unaided eye, but when any doubtful specimens were found they were examined with a microscope and the presence of particles of chalk could then be determined accurately. During the first few days after liberation most of the flies were strongly coloured, but later the specimens retained the colour mainly on the halteres.

The sex and species of the marked flies recovered were determined, and in many cases the percentage of the different species of unmarked flies in the recovery traps was estimated by examination of a certain number of flies, and in the same way the sexes were estimated in a number of instances. The weight of the catch in each recovery trap was also determined.

SUMMARY AND CONCLUSIONS.

The experiments carried out show that under rural and urban conditions flies have marked powers of diffusion.

The maximum distance of spread from the point of release as recorded in these tests was as follows for the several species: The House Fly, *Musca domestica*, 13.14 miles; the Screw Worm Fly, *Chrysomya macellaria*, 15.1 ~~miles~~; the Black Blow Fly, *Phormia regina*, 10.9 miles; *Lucilia sericata*, 1.2 miles; *L. caesar* 3.5 miles; *Synthesiomyia brasiliana*, 0.5 mile; Blow Flies, *Sarcophaga* spp., 3 miles; *Ophyra leucostoma*, 7 miles; *O. Aenescens*, 1.1 miles.

The estimated total number of marked flies liberated in all the experiments reported upon was 234,000.

In these tests it is considered that too few individuals of species other than *Musca domestica*, *Chrysomya macellaria*, and *Phormia regina* were liberated to form a reliable guide to their dissemination tendencies.

Marked flies of all species dispersed in all directions from the point of liberation.

Among the stimuli inducing dispersion the desire for food and the desire for places for oviposition appear to be among the strongest.

The fact that many towns, farmhouses,and other favourable feeding and breeding grounds were passed by the flies shows that *Musca domestica*, *Chrysomya macellaria*, and *Phormia regina* at least are not satisfied by the mere finding of these places but have marked migratory habits.

Chrysomya macellaria evinces stronger tendencies toward migration than does *Musca domestica*. This tendency in *Phormia regina* under optimum climatic conditions for the species is probably equal to that in *C. macellaria*. The other species were liberated in numbers too few for conclusions to be drawn, but *Ophyra leucostoma* and *O. aenescens* show marked ability to travel considerable distances.

The exact relation between direction of dispersion and direction of wind could not be determined from the results of these experiments because of the choppy wind conditions experienced. There appears to be a tendency for *Musca Domestica* and *Chrysomya macellaria* to go with the wind in greatest numbers, but they are shown to travel against and at right angles with it as well. It is concluded that under natural conditions the influence of moderate winds on dissemination is not of great importance.

The evidence gained justifies the conclusion that the passing of vehicles along the highways was not a dominating factor in the dispersion of any species of flies in these tests. This does not mean, however, that flies under other conditions may not be widely scattered by artificial means.

These tests show that the house fly, screw-worm fly, and black blow-fly spread rapidly for many miles. *Chrysomya macellaria* was recorded about 8 miles from the point of liberation in less than 24 hours and 10 miles in less than 48 hours after liberation. *Phormia regina* was recovered about 11 miles away in less than 48 hours after release. *Musca domestica* was recovered over 6 miles from the point of release in less than 24 hours.

Males as well as females of the principal species used in these experiments may travel many miles.

The maximum longevity of the marked flies after liberation as shown by the records of capture was: *Musca domestica* 15 days, *Chrysomya macellaria* 17 days, *Phormia regina* 10 to 11 days, *Ophyra aenescens* 6 to 8 days, *Sarcophaga Spp.* 11 to 12 days.

While in the fourth experiment no marked flies were captured in the more distant traps (about 17 miles from the point of release), it is the author's belief that the limits of dispersion were not reached in that test and that where great numbers of flies are emerging constantly the distance traversed may be much farther than the maximum here determined.

The facility with which flies travel many miles emphasizes the importance of the general application of sanitary measures looking toward the suppression of fly-breeding.

THE DESTRUCTION OF RATS.

The necessity for rat destruction cannot be questioned. Statistics show the enormous material damage, amounting to many millions of pounds sterling annually, caused by rats and mice in destroying property, especially stored and growing foodstuffs; while the danger of rats and mice as carriers of diseases which attack human beings and domestic animals is well known.

Methods of Destruction.—Four methods of rat destruction are available, namely, hunting, trapping, the use of a virus, and poisoning. The rat population is largely limited in numbers by the available food supply and shelter. Adequate rat proofing is therefore desirable wherever practicable: this alone will tend to reduce their numbers considerably.

The first two methods need not be discussed at length; both are limited in their application, and in the case of trapping there is difficulty in taking sufficient numbers to clear badly infested areas. Further, rats soon become wary of traps of all kinds and avoid them. Mention might here be made of the method of destruction known as the "Rodier" system. This depends on trapping alive, destroying all females caught, and releasing the males. It is supposed that the males, then greatly outnumbering the females, will prey on each other and on the surviving females.

The virus method, when introduced some years ago, was hailed as a great advance in scientific rat destruction, but experience has hardly justified the claims made for it. It may be well to explain the method. Some years ago a French scientist found that the mice in a certain area were dying in unusual numbers, and on investigation the cause was traced to an intestinal germ. After many experiments he succeeded in isolating and cultivating the germ artificially, and raising its virulence until it was strong enough to kill not only mice but also rats. It had, however, no effect on other animals. The virus method depends on feeding the rats with baits containing cultures of living germs; these infect the animals, which die in 10 or 12 days, and the disease spreads among the survivors. Several types of virus or germ rat poisons have been placed on the market. Unfortunately there are objections to this method which, in many respects, offers an ideal means of destruction. These objections are:—(1) the varying susceptibility of the rats to the disease, as some do not die when they take the germs; (2) sublethal doses tend to immunise the rats to the disease, so that a relatively immune race of rats would be evolved; and (3) there is the risk of the organism used being either initially pathogenic to other animals or developing in its passage through the rat a higher virulence which might affect other animals, and even human beings. Cases of illness in human beings have been attributed to rat virus. (4) Lastly, there is some

doubt as to the extent to which the disease is transmitted from rat to rat, for as it is not a contagious disease it can only be transmitted by ingestion of the germs. For these reasons the Ministry of Agriculture and the Ministry of Health do not favour the virus method of rat destruction. Bacteriological science has not, however, said its last word on this subject, and the objections may be overcome in the future.

Poisoning is by far the most important method. With proper precautions it can be used anywhere; when suitably applied it is remarkably effective; and it therefore offers the best solution of the problem at present. Poisons are substances which, when introduced into the living organism, cause death or injury. (Strictly they include disease germs, but for the present purpose these are excluded.) Some substances, such as strychnine and morphine, are dangerous poisons, but if given in small quantities are valuable drugs. Other substances, such as bismuth or iron salts, and strong vegetable purgatives, are not ordinarily regarded as poisons, but if taken in excessive amounts may come within the above definition. There is a large field from which to choose a rat poison.

It should be noted that all methods of rat destruction should be carried out in conjunction with rat proofing, for in the end it is largely the amount of shelter and food available which determines the rat population.

Why Research is Necessary.—From the above remarks on the virus method, it is clear that there is a wide field for further work, which can only be done in properly-equipped bacteriological laboratories by a scientific staff. In the case of poisons, it might be thought that the need for research is not obvious, but poisoning is a certain and much-used method and the need is real. It is necessary to know, for instance, what is the least quantity of poison which will kill a rat of average size; what quantity to put in the bait; and how much bait to use. All these points require experimental tests, and the necessary experiments can only be carried out under a licence from the Home Secretary. Another very important question is the extent to which poisons are dangerous to

other animals, and this is one of the chief directions in which research is being carried out, *i.e.*, to endeavour to find poisons which, while fatal to rats, will be relatively harmless to domestic animals and human beings. The stability or keeping qualities of poisonous preparations involves much purely chemical research. Even trapping is not so simple as it seems, for experiments in India and elsewhere show that the dimensions of the trap are of great importance.

For these reasons the Ministry of Agriculture, acting on the advice of the Rat Destruction Branch, decided to equip a research laboratory for work on this subject, and further, since the Government were occupiers under the Rats and Mice (Destruction) Act, 1919, it was decided to run a small factory in conjuction with the laboratory for the purpose of supplying suitable raticides for use on Government premises. Apart from this there is an intimate relationship between the work of the Laboratory and the Factory: results obtained in the Laboratory can be checked by practical tests on a fairly large scale.

As an example of the problems to be solved, an account of the Red Squill referred to above may be interesting. The Red Squill is a bulb not unlike a large reddish onion and varies from ½ lb. to 2 lb. in weight. It grows in various countries on the Mediterranean littoral. Very little is known of the chemistry of this plant, and the little that has been published is scattered in various German books, making progress slow. The plant is similar to the Squill of medicine, and its poisonous properties, so far as rodents are concerned, have been known for a very long time, though the white medicinal bulbs do not appear to be poisonous to rats. In the raw state the bulb is poisonous, but baits containing chopped-up bulb do not retain their toxicity very long. If, however, the bait be cooked its keeping quality is greatly increased. The bulbs when dried and powdered are also toxic, though the powders thus made vary a good deal, and the exact conditions necessary for ensuring maximum strength are not understood. The minimum lethal dose of powdered bulb for a medium-sized rat is from 1 to 2

grains. A liquid poison can also be obtained by steeping the bulbs in water and pouring off the liquor. If kept in tightly-stoppered vessels this extract keeps toxic for a considerable time. The actual poisonous substance in these bulbs is not known, though two or three substances are said to have been isolated, but the descriptions are very conflicting. Whatever it is, it must be fairly powerful. Further, it is not known whether the toxicity of the bulb varies at different stages of its growth, though this is very likely, and it is important to know when it is most toxic. Neither is much known as to the exact quantity required to kill domestic animals, though it is certainly relatively large. A South African variety of Squill (*Urginea Burkei*) is being investigated. It appears to be poisonous to rats. Work has also been done on possible alternative poisons to those in present use, so far, however, with inconclusive results.

Other poisons.—It has already been indicated that the choice of a poison is very wide; the poisons actually in use, however, are comparatively few. It may be well to summarise the requirements of a practical rat poison. It must be:—

1. Relatively harmless to domestic animals.
2. Cheap and readily procurable.
3. Effective on rats and mice, that is, reasonably small doses should kill.
4. Tasteless, or, at any rate, without a repellant taste.
5. Easy and clean to handle and be readily incorporated for making the bait.
6. Capable of keeping well and retaining its toxicity.

These conditions narrow down the choice considerably, and there are not a great many substances which will satisfy them. The first condition practically eliminates all the substances popularly recognised as poisons; nevertheless a great many of the rat poisons on the market contain either arsenic, strychnine, or phosphorus, the last named being especially popular, partly because it can be bought without the restrictions of the Pharmacy Act, which apply to the first two. Where there is little or no risk of poisoning other animals, the use of

these poisons is safe enough, and they are certainly effective, though arsenic is somewhat variable in its results, while the use of phosphorus is attended by some risk of fire. Actually, strychnine is said to be cheapest, per rat killed. As a general rule, however, the indiscriminate use of these dangerous poisons is to be deprecated, and the use of alternative and less dangerous poisons should be encouraged.

Of the less dangerous poisons Barium Carbonate and Red Squill have been found most effective for killing rats. In fact, they are just as good and cheap as the more dangerous poisons, and they have the great advantage of being far less poisonous to domestic animals and human beings.

The Composition of Baits.—There is, of course, no such thing as a poison which will kill rats and mice and nothing else; what is wanted is to reduce the risk as much as possible by using poisons to which rats and mice are peculiarly susceptible. Now the success of a rat poison depends not so much on its actual toxicity as on its being presented in a form that is acceptable to and readily taken by the rodents.

Apart from mere palatability, several points require consideration, such as the size of the bait and the amount of poison in it. A bait should be small enough for a hungry rat to eat it all, and should contain enough poison to kill. If a bait will kill even if only half of it is eaten, so much the better.

Experiments carried out at the Laboratory showed that rats eat about one-tenth of their body weight per diem; hence a bait of 30 to 60 grains is suitable and represents about one-tenth of a day's food supply. Each such bait should contain a lethal dose; to obtain this the following percentage of toxic agent in the baits prepared are used :—

Arsenic 5%	Each bait being about 20 grains.			
Barium Carbonate 25%	,,	,,	,, 30	,,
Squill Bulbs 20%	,,	,,	,, 50	,,
Squill Powder 20%	,,	,,	,, 25	,,

Baits should be prepared in such a way that they are ready for use; such operations as spreading on bread, etc., should be avoided. The quantity to be used should be clearly stated in common measures, such as a tea-spoonful. It is, however, an advantage to prepare the bait in tablet or biscuit form, as the quantity used and the amount of poison per bait are then easily controlled. The most important point of all is that the bait should be attractive to the rodents, and this can only be decided by experiment and observation in the Laboratory followed by field trials. It is here that the close association of the Factory and Laboratory is specially valuable.

Each poison should be made up in several varieties of bait, so that if one kind is not taken a change can be made. The most frequently used bait is a mixture of oatmeal and fat, to form a hard paste; this is more useful in winter than in summer. Another very useful way is to mix the poison with flour, work up into a dough, and prepare biscuits or tablets, which are then baked. Variety of flavour can be obtained by introducing such substances as grated cheese (the older the better), minced fish or fish meal, and sugar. Baits with no natural odour are slightly flavoured with aniseed or rhodium oil. Differences of opinion exist as to the advantages of this, but slight flavourings are generally favoured.

Successful rat destruction depends not only on the choice of suitable toxic agents, made with due regard to their chemical and toxic properties, but also on the adaptability of the baits to the varying tastes of the rat. In England, the rat generally prefers variety, *i.e.*, in a cheesemonger's the best bait would probably be fish. In India, however, it is found that a bait similar to their usual diet is most successful.—*Journal of the Ministry of Agriculture.*

RESUME OF MEETINGS OF THE BRITISH GUIANA SUGAR PLANTERS EXPERIMENT STATIONS COMMITTEE, HELD DURING THE YEAR 1921.

A meeting of the British Guiana Sugar Planters Experiment Stations Committee was held on Monday, the 17th January, 1921, when the following members were present:—Hon. Prof. J. B. Harrison, C.M.G., Chairman, Messrs. R. Strang, A. E. Craig, A. E. Bratt and the Hon. R. E. Brassington.

The matter of the importation of Cane Tops from abroad by sugar estates was discussed and the meeting agreed to ask the Board of Agriculture to prohibit importation of such tops except by, or through, the Experiment Stations Committee. Any tops imported in future would then be taken charge of by the Committee and cultivated under strict observation and control.

A meeting of the Committee was held on Monday, 14th February, when the following attended:—Messrs. W. Francis, acting Chairman, A. E. Craig, J. C. Gibson, W. M. B. Shields and the Hon. R. E. Brassington.

The Committee passed an agreement for the lease of 110 acres of land at Pln. Sophia, being an extension of the Station of approximately 60 acres. The feeling of the Committee was that no time should be lost in starting the subsidiary District or Country Stations.

The Committee met on Monday, 18th April, when Messrs. W. Francis, acting Chairman, W. M. B. Shields, J. C. Gibson, A. E. Craig, A. E. Bratt and the Hon. R. E. Brassington were present. Mr. Gibson tendered his resignation as a member of the Committee. A Report on the Agricultural Conditions of the Cane Sugar Industry in British Guiana with suggestions for their development was submitted to the Chairman and members of the Committee by the Superintendent. Authority was for copies of the Report to be

printed for circulation. The Superintendent was requested to write a report on the organization of the subsidiary stations.

A meeting was held on Monday, 6th June, when Messrs. W. Francis, acting Chairman, R. Strang, W. M. B. Shields and H. Deverill were present. A letter from the Hon. R. E. Brassington was read notifying the Committee of his intended departure from the Colony and suggesting that Mr. Jas. Smith should act as his *locum tenens.*

On Monday, the 11th July, the Committee met when Sir John Harrison, C.M.G., Chairman, and Messrs. R. Strang, W. M. B. Shields and A. E. Craig were present with Mr. Jas. Smith, who had been appointed by the Planters' Association to be the *locum tenens* for Mr. Brassington during his absence. The Chairman informed the Committee that the results of the Sugar Cane Returns had been collated and would appear in the Journal of the Board of Agriculture for July. The Chairman promised to give instructions for extra copies to be printed for distribution to the various estates.

The Committee met on Monday, 15th August. The following members were present:—Sir John Harrison, C.M.G., Chairman, Messrs. R. Strang, A. E. Bratt, A. E. Craig, W. M. B. Shields, Jas. Smith and R. H. Payne who had been appointed by the Planters' Association as *locum tenens* for Mr. Deverill during his absence. On the recommendation of the Superintendent it was decided to subsidize the cultivation of certain seedling plots at Pln. Anna Regina.

It was decided to publish the annual Report on the working of the Experiment Stations in the Official Gazette.

The Committee paid a visit of inspection to Sophia Station on Tuesday, the 23rd August. The opinion was expressed that the cultivation was looking very healthy and being kept in a very satisfactory condition. The drainage was also considered satisfactory. The question of extending the cultivation was considered. Mr. Strang said that when the station was first started it was agreed

that the whole area would be required for cultivation of seedlings with the exception of the very low lying lands to the north and a portion of the very high land to the south, the idea being that it would afford an opportunity for the Superintendent to follow the growth of all the seedlings and be able to form an opinion as to which seedlings were giving good results. Mr. Strang considered that other stations were necessary for the extension of those varieties which had been proved by the trial at Sophia to be worthy of it. Mr. Shields agreed with the remarks made by Mr. Strang. He considered that the extension of tried seedlings should be carried out at the Sub-Stations. Mr. Craig also agreed with the views of these two members. He thought that they should go ahead at once with the clearing of the additional land. Messrs. Smith and Payne concurred in these views.

A meeting was held on the 12th September when the estimates of expenditure for the ensuing year were gone through and passed. It was unanimously agreed in view of the present critical condition of the Sugar Industry and of the Committee having a large portion of the funds subscribed in 1919 and 1920 unexpended and available to carry on the cultivation at Sophia, to recommend to the Sugar Planters' Association that the assessment for 1921—1922 be ten cents per acre.

The Committee met an Monday, 14th November, when Sir John Harrison, Chairman, Messrs. Strang, Shields, Craig, Deverill and Smith were present.

The Board of Agriculture Order with reference to the importation of Cane Tops was read at this meeting. A letter was also read from the Secretary of the British Guiana Sugar Planters' Association fixing the assessment for the ensuing year at the rate of ten cents per acre.

SOME PLANTS WORTH KNOWING.

By J. F. Waby.

Beaumontia grandiflora, introduced from the East Indies. A very strong-growing climbing plant, with large dark shining foliage, and large pure white highly fragrant tubular flowers. It used to be considered among the rubber yielding plants, as on being cut or injured a white sticky fluid exuded, but evidently the yield was not sufficient to warrant its cultivation for that purpose.

My first acquaintance of this plant was in the avenue of the Botanic Gardens in Demerara, quite a young plant on a small tree producing only a few flowers, but it also produced fruit,—a large Cucumber-like fruit pointed at both ends, dehiscing in several valves, showing long narrow seeds with a silky coma attached. Here in Trinidad, although the plants cover the branches of some of the largest trees and bloom profusely, the fruit has never been seen. The foliage is closely set in alternate pairs, completely covering the stems of the branches, ten inches long 3—4 inches wide, dark shining green above, pale green beneath, veins very prominent, petiole 1—1½ inches long, quite strong, base of leaf long, cuneate, all the young growth is tomentose. Here there are 2 or 3 varieties apparently, though the differences would only appear in the smaller size of foliage and flowers. The description here given is of the original plant in St Clair Nursery, which is the same as that in the Botanic Gardens, Demerara.

Inflorescence axillary among the foliage on the young vigorous growth, a short sturdy panicle of six to a dozen flowers, the panicles borne profusely. Peduncle 1½inches long, very strong; calyx 1¾ inches long, of five large, pale yellowish green sepals. Tube 4—5 inches long, 1¾—2 inches wide, narrowing to ¾ inch at base with 2 inches narrowed tube inside calyx. Orifice of tube 2 inches across, with 5 crenulated segments outside, this 2 inches long, 1½ inches wide, making the whole expanse

at least 5—6 inches across, five stamens attached to the tube a little above the points of the calyx, and a pistil collected in one group just below the orifice of the tube; stamens white edged with pink, pistil green with a snake-like head for stigma.

Stifftia chrysantha, from Brazil. A hard-wooded spreading shrub with brittle branches. Foliage set close, alternate $\frac{1}{2}$ inch or so apart, shortly petioled lanceolate, acuminate, 3—4 inches long, 1—$1\frac{1}{4}$ inches wide, smooth, entire, glabrous both sides, only midrib distinct, veins obscure. Inflorescence terminal, solitary, composed of many individual flowers springing from the torus amongst the pappi, the pistils with the enveloping syngenecious stamens well above the pappi. Peduncle $\frac{3}{4}$ inch long, stout, upholding a green involucre of 5 or 6 rows of thin shell-like incurred fragments founding the torus, in lines covering each other, wide outside and narrow inside, of various lengths to an inch long. Ovaries many $\frac{1}{2}$—$\frac{3}{4}$ inch long, narrow, supporting a silky yellow pappus which spreads open on the flowers falling, each 2 inches wide; these remain for some considerable time and make believe a second flower is produced a much larger size than the first straight one but all of one colour. Individual flowers 1 inch with pistil extruding $\frac{1}{2}$ inch; tube orange coloured, narrow; lips curled back, extruding point of pistil dark brown with whitish bifid stigma; whole arrangement 2 inches long. 1 inch base to $1\frac{1}{4}$ inches spread of complete flower of separate pappus. The brown portion of the pistil is the collected stamens, each separate flower is surrounded with a number of dark reddish-yellow filaments 1 inch or more long, attached to the ovary which is $\frac{1}{2}$ inch long and $\frac{1}{16}$ inch thick. The last stage of the inflorescence has a spread of 4-5 inches. Seed is very rarely produced. it can be propagated by cuttings, layers and suckers.

Spathodea campanulata, the "Cork" tree of Western Tropical Africa. It is a most beautiful tree and very desirable whether for its foliage or its glorious blooms, both are striking and the plant gives very little trouble when once established, except to prevent its spreading by suckers which it is likely to do. It carries a fairly stout

though rather soft stem and the head does not spread unduly, the branches are brittle, the foliage is pinnate generally of 7½ pairs of leaves, these set 2½ inches apart, almost sessile, 4 inches long, 2—2½ inches wide, pointed, dark green above, pale beneath, midrib and veins tinged with pink in full sum, 3—5 small green glands at base of petioles. Inflorescence a strong terminal raceme, set in a close cone 6 inches or more long; individual flowers very close together with peduncle an inch long, opening few at a time. These campanulate, orange-scarlet, ribbed edges crimped with yellow:—the shape, flattish, bonnet-like with scolloped fringe,—corolla 4½ inches deep, 3 inches across, edges 5 clept, 1½ inches deep, inner space with a number of lines running from the base upwards; base-tube ¾ inches long, ⅜ inch thick on one side. Four stout pale orange stamens attached to the base-tube, 3 inches long, curving with the shape of the flower, with dark coloured anthers arching downward: a stout pistil with curved style 3 inches long and a short triangular bifid stigma. The calyx is 2½ inches long, undivided, pointed, ribbed, thick folded one inch on either side of the base of the corolla, trending backwards, soft, smooth, glossy brown outside, smooth purplish inside. The fruit is 6—7½ inches long, 2 inches wide, dark brown, woody, dehiscing in the middle of one flat side; a stout replum occupying the centre, to both sides of which small flat seeds with all-round gauzy wings are packed as closely as possible. The fruiting of this tree is rare. The empty case is an exact miniature of a 4 planked, pointed bateau used for shallow trenches.

The "Chalice flower". *Solandra grandiflora* of Jamaica. A strong-growing climber with green soft-wooded far-reaching shoots, densely clothed with foliage, and throwing out aerial roots all along its stems and branches which cling to the tree stems or reach the ground if not toc far off, the moister the position the more are these roots produced. The plant is a most useful one and may be trained as a shrub, on an arch or trellis, or allowed to take its own way up the largest tree; in any of these conditions it is a beautiful object. Given a free exposure it forms long shoots, making

branches as it climbs. Being curtailed on a trellis, the long shoots must of course be pruned, this causes a quantity of spurs to form, each of which will provide blooms.

The flower is solitary, strongly perfumed, tubular, the calyx joined at the base around the ovary, opening at about 1 inch above into 2 green pupery sepals 3 inches long, a wide and a narrow, one with one corner, the other with two, these persistent with the fruit.

The flower is composed of a continuous tube, the base only $\frac{1}{4}$ inch wide and 6 inches long, opening out suddenly into a "chalice" 6 inches long and $2\frac{1}{2}$ inches wide, mouth 2 inches across, whole expanse of 5 segments outside the mouth, $4\frac{1}{2}$ to 5 inches across, segments fringed. Ten chocolate coloured thick lines running down from mouth to base inside, 5 green thin lines on outside; 5 stout curved cream-coloured stamens attached to the base of the chalice and reaching to the mouth, with large dark brown flattish anthers, $\frac{1}{4}$ inch long and $\frac{1}{8}$ inch wide; a stout cream-coloured style with green stigma, reaching one inch above the mouth. The colour of the flower deepens each day for about 3 days into a golden yellow and then it falls off leaving the long pistil hanging from between the sepals of the calyx at least 11 inches long. The flowers are produced on short spurs amongst a rosulate bunch of leaves. The fruit,—with the persistent calyx which opens out in 5 segments,—is conical pointed, $\frac{1}{2}$ inch deep and the same in diameter at the base. The seeds are like pepper-corns, set close together.

Rondeletia. It is astonishing what a difference a few years makes to an individual, and the circumstance I am about to relate is only one of many. I came to Trinidad in September, 1873, and left that colony on promotion to Demerara in December, 1878. In Trinidad I left growing in the Flower Garden 3 plants of Rondeletia, *R. speciosa*, *R. speciosa minor* and *R. odorata*, five specimens of each. I return after an absence of 40 years, all 3 specimens have disappeared; but I find in St. Clair, *R. odorata*, which to my mind is identical with *R.*

speciosa, and in another part of the gardens *R. eriocarpa* which to me is *R. odorata*. Several authorities have been in charge of the gardens since my time, as also that of Mr. Henry Prestoe, but that does not account for the change of names in these particular plants. As at present named *R. odorata* and *R. odorata minor* have not a particle of perfume, and *R. eriocarpa* is powerfully odoriferous. What has caused the change of names?

R. speciosa (original) forms a large spreading shrub as wide as high of hard brittle branches. Inflorescence in terminal panicles and laterally in thyrses, much like small-flowered Ixoras, the thyrse $\frac{1}{2}$—2 inches across, individual flowers $\frac{5}{8}$—$\frac{3}{4}$ inch across, deep scarlet with an orange centre, campanulate of 5 deeply cleft segments, with a narrow tube $\frac{1}{2}$ inch long, fitting into a calyx with 5 filiform green sepals $\frac{3}{8}$ inch long. The foliage in pairs, about $1\frac{1}{2}$ inches apart, almost sessile, $1\frac{3}{4}$—2 inches long, $1\frac{1}{8}$—$1\frac{1}{4}$ wide in the middle, bluntly pointed, entire, rather rough surface, dark green above, very pale green beneath, midrib and veins very distinct. *R. speciosa minor* is practically a replica of *speciosa* but in every part of it much smaller, growing much more compact and more floriferous. Both are difficult to propagate on account of the hard wood, branches laid on the ground root fairly freely and suckers are occasionally thrown up. When seeds are produced this is a means of sure propagation; these are to be found occasionally in small capsules after the flowers have dried.

Rondeletia odorata (*eriocarpa*) forms a less compact shrub, being more like *Petrea erecta* in growth, with a few stout stems much branched, though altogether much larger growing than *R. speciosa* and of much harder composition, the stems and large branches of a decidedly smooth and grey bark. Foliage in pairs, 1—2 inches apart, oblong, shortly petioled, varying from 4—6 inches long, 2—3 inches wide, entire, ordinary green above, pale beneath, midrib and veins prominent. Inflorescence a large terminal panicle of separate thyrses in loose character. Individual flowers,

tube $\frac{1}{2}$ inch long, narrow, fitting into a short green calyx of 5 small star-shaped sepals campanulate top $\frac{3}{8}$ inches across of 5 segments, pale cream colour. Fruit a rounded capsule $\frac{1}{4}$ inch diameter.

Solanum macranthum of Brazil. This is a fast growing tree-form of the potato family, very desirable as an ornamental object in Flower Garden or Pleasure-ground, entailing no trouble whatever once it is established; but this should be in a spot sheltered from the chances of heavy wind-storms, because it always produces a head much larger than its stem or root structure is able to bear, more particularly in a loose soil. The stem in 4 to 5 years is at least 7 inches in diameter, of not particularly hard woody nature, rather rough brown bark with sharp thorns $\frac{1}{2}$ inch long, widely apart. The spread of its head at this age is 36 feet, height 25—30 feet, so that to all appearance it is top-heavy, and it is easy to understand that it is in danger of toppling over unless protected by stays. The branches are numerous and spread in all directions forming a well shaped head. Foliage 7—9 inches long, with $2\frac{1}{2}$ inches petiole, 5—$6\frac{1}{2}$ inches across the widest part, deeply lobed, dark green above, paler beneath, hairy both sides, leafstalks and midribs with a few green and yellow strong sharp thorns $\frac{3}{4}$ inch long, all the green parts hairy, midrib strong, as also the ribs running into the lobes, with interlacing veins between. Inflorescence, axillary, shortly paniculate, few branched. Individual flowers 2 inches across campanulate, 5 lobed, lobes $\frac{3}{4}$ inches deep, serrate; first flower deep royal purple, turning to all shades of paler purple to almost white, many shades of colour appearing at the same time; filaments yellow, clustered in the centre; calyx of 5 filiform sepals $\frac{1}{2}$ inch long, green, hairy.

Fruit a green apple, turning yellowish green, then brown, $1\frac{1}{2}$—2 inches diameter,—filled with acrid juice which escapes on the fruit falling to the ground and cracking. Set in a strong cupped calyx with 5 sepals like claws clasping it, Stalk stoutish, an inch or more long. Seeds like brown Tomato seeds in a mass of pulp.

Kigelia pinnata, the "Bull's-cod," "Sotor," "German" sausage tree of tropical Africa. It is not a large growing tree and spreads more laterally than in height. It has a fairly thick stem, rather gouty with a thick tense bark. The branches are fairly thick and brittle and spread loosely in all directions. The foliage is pinnate, arranged triangularly, each set 1½ inches apart, stiffly outwards, each leaf 12 inches long of 3½ pairs of leaflets, each pair set widely apart, leaflets with ¼ inch petiole, 3—4½ inches long, 2—2½ inches wide at widest part, entire tense, leathery, plain green both sides, midrib and veins plain. Inflorescence 2 feet long, 9 inches across, general ramal from bare branches, rarely terminal, strong, pendant, racemose; individual flowers in threes (these fairly close together), the threes several inches apart; peduncle 3 inches long, bending downwards and turning upwards near the flower. Calyx campanulate with 2 or 3 clefts, 1½ inches long, with 2 divided sepals of 2 clefts each or a 3rd point, pale green with darker green stripes up centre of points. Corolla campanulate,—much like immense gloxinia blooms—4½—6 inches diameter, orifice 2 inches across, 1¼ inches deep; 4 lobes, lower one broad, 2 side ones pointed, upper one cleft and pointed, lobes with crinkled edges turned back, orifice smooth. 4 stout stamens—2 long and 2 short—attached to the short tube and bending with the orifice, anthers large, forked downwards; front of flower deep chocolate colour, base of stamens whitish, hairy; back of flower with yellowish stripes ¼ inch apart, grading to the narrow tube; colour between stripes pale claret, base of tube yellow. The odour from the flower is rather malodorous, which is so generally associated with flowers of such sombre colours. The flowers are short lived, they open at dusk and fall next morning leaving the pistil in the calyx, this is short, stout, 1½—2 inches long, whitish with a flattish thick triangular stigma. The fruit indehiscent is of various sizes up to 11 or 12 inches long and 4 inches wide, solid, sausage-shaped, speckled brown; these hanging solitary or 2 or

3 together on long stout strings. The interior of the fruit is something like the calabash with the seeds scattered through the pulp.

WIND BELTS AND HEDGES.

Plants growing in situations which are exposed to wind suffer more or less according to the force of the wind in the particular situation. For this reason it is necessary to provide barriers for protecting cultivated plants and trees in order that we may attain the fullest development and produce their best crops under the most congenial conditions.

These barriers generally take the form of hedges of growing plants and trees of a hardy nature which can withstand the force of the wind, grow to a much greater height than the cultivated plants or trees and have a sufficiently dense foliage from the ground up to the highest branches to form an effective barrier to the wind.

These wind belts give protection to the cultivated plants directly, from the force of the wind on their branches and foliage. The cultivated plants derive benefit from wind belts indirectly also in the following ways. Wind belts protect the surface of the soil from the drying effect of the wind sweeping over it, and therefore assist in the conservation of soil moisture; and for the same reason preserve the necessary humidity in the field. Wind belts, in preventing the wind from sweeping over the surface of the foliage, benefit the plants by preventing too rapid transpiration from the leaves.

Young cultivations of permanent crops and annual garden crops require more special protection from wind than established permanent cultivation, for the reason that being of a more tender nature and requiring more moisture in the soil, atmosphere and foliage, they suffer more from wind than the older and hardier plants and trees.

Steep mountain lands exposed to the wind deteriorate rapidly after being cleared of forest, unless wide belts of forest trees are left to serve as wind belts.

Temporary hedges of quick growing hardy plants are necessary to protect young cultivation, until the taller and hardier and slower growing permanent wind belts take their place. These hedges may also be grown in situations where a short growing wind belt is required merely for the purpose of protecting the surface of the soil from the drying effect of the wind. Aralia and Hibiscus, which, grown under almost any condition to a height of from ten to fifteen feet and retain their foliage throughout the year, are the most suitable for short, quick growing hedges. These are grown from cuttings set in single or double rows at one foot apart.

Among the many kinds of trees suitable for wind-belts may be mentioned Galba (Catophyllum Calaba,) Mammee Apple (Mammea Americana), Cloves (Calyophyllus Aromaticus) Honduras Mahogany (Swietenia Macrophylla), Mango (Mangifera Indica), Camphor (Cinnamonun Camphora), and the Malacca apple tree. All of these make tall, thick, hardy wind belts and Cloves and Camphor are of economic value, the production of which does not interfere with their value as a wind belt. Mammee Apple, Mango and Malacca Apple produce fruit of some value.

As to the best distance at which wind belts should be spaced, a good deal depends on the topography of the land. At the same time it may be stated that for level land 400 feet is a fair distance. The individual trees in the wind belt should be spaced at from five feet to ten feet apart according to its wide or narrow branching habits.

In selecting trees for wind belts the planter should avoid growing those which are host plants to insect pests and diseases to which his cultivated plants are susceptible.

It is necessary to isolate the roots of the wind belts by a deep drain or trench, on each side, at about fifteen feet from the stems of the wind belt trees.—*Proceedings of the Agricultural Society of Trinidad and Tobago.*

AGRICULTURAL NOTES.

Improving the Native Fowl in Northern Nigeria.

Particulars of a successful experiment, which has been in progress since 1919, to improve the native fowl in Northern Nigeria by crossing them with pure breeds imported from England, are supplied by Mr. P. H. Lamb, Director of Agriculture for the Northern Provinces of that country.

Through Mr. P. Hedworth Foulkes, Principal of Harper Adams Agricultural College, Newport, Salop, two cockerels and six pullets of each of the following breeds were obtained :— Indian Game, Light Sussex and Rhode Island Reds. The cockerels were not related to the pullets or to one another, for the future introduction of fresh, pure blood would be difficult. Two of the Light Sussex died on the voyage; the remainder were placed on arrival at Kaduna in specially prepared pens affording protection from the mongoose and wild cat. The site was elevated, well drained, and previously free from poultry.

The native fowl is described as having the appearance of an ill-conditioned bantam, and its utility qualities either as a table fowl or as a producer of eggs are very poor. The country experiences great extremes of temperature. During the hot (which is also the wet) season from April to September the thermometer rises to 104° F. in the shade; while during the cold dry season, from October to March it drops to 45° F. There is almost continuous rain for six months, and the country is parched and produces no natural green food for the remaining six months. The staple food of the country is Dari (*Sorghum vulgare*) known as guinea corn. It is also the corn commonly fed to the poultry, and in the case of the imported fowls it was dug into the litter first thing in the morning, followed at 4 p.m. by a soft feed of boiled sweet potato (yam) mixed with green bone. In the dry season, when there is no natural green food, chopped lettuce grown specially in gardens which are watered daily was

fed to the birds. From January to March mussels obtained from the shrunken river beds were given, the pounded shells being fed as shell grit all the year round. Some maize was fed to growing stock, but wheat and other European grains are scarce.

With the exception of a short period at the beginning of the dry season in October, hens lay eggs all the year round in Northern Nigeria. Moulting takes place between August and November. As there is no skilled labour on the Kaduna breeding station, only natural hatching is resorted to, and this goes on throughout the year, the best results being in March. The percentage of eggs hatched varies from 60 to 90. Newly-hatched chicks are fed on broken wheat, broken dari, and millets, and the larvæ of termites (white ants), boiled rice being added a few days later. Charcoal is fed to birds of all ages, and chickens have it powdered in their soft food (yam). Glauber salts and iron sulphate are put in the drinking water for 24 hours each week, and sulphur is mixed in the soft food in very hot weather. The problem of insect pests is a serious one, lice, red mite and poultry tick being common among the native poultry, the last named being much dreaded as a disease carrier. As a preventive, all the birds on the station are dipped once a quarter in a 5 per cent. paraffin emulsion, while any houses badly infested are burned. This treatment has proved very successful. The only disease from which the imported poultry have suffered so far is chicken pox, which is enzootic among the native fowl and was probably introduced with the bran bought at a local market; no native fowls are kept within a quarter of a mile of the breeding station. This disease ran through the whole yard, but yielded readily to antiseptic treatment, there being no mortality. No egg records are available, as the number of birds has varied and all the hens have been used regularly for sitting. It is hoped to raise on the breeding station a large number of pure bred fowls, and in the first place to distribute the cockerels (by sale) to the chiefs of the villages in order to improve the native fowl by crossing. The first crosses with the native fowl are half-caste in appearance and intermediate in size

between the imported and native breeds. Over 100 of the pure-bred cockerels reared at the station have already been distributed over an area extending from Sokoto to Lake Chad.

IMPROVING OUR DAIRY HERDS.

By D. W. May.

The following note from the Porto Rico Agricultural Experiment Station relative to the successful methods adopted for the improvement of the dairy herds in that Island is of interest; a similar procedure has been in vogue in British Guiana for many years and the dairy stock imported by the Board of Agriculture has had a marked effect in raising the standard of local dairy breeds of cattle.—Editor.

There is much improvement going on in Porto Rico in increasing the yields of our dairy cattle. This can be greatly aided by a little more study on our part. The first question to be considered is the improvement of the breed. This can be the more economically brought about by the importation of pure bred bulls. This station started several years ago with a herd of native cows and a pure bred bull brought from the States. When the resulting cross-bred calves were old enough to be bred, another bull of the same breed was brought from the States and now a third bull has just arrived at the station. The native cows of our foundation herd gave an average yield of milk per day of 8.09 pounds. Their daughters, half-bred cows, gave an average yield of 11·9 pounds. The granddaughters, being three-quarters improved blood, gave an average yield of 13.5 pounds. This shows an increase of 47 per cent. of the half-bred cows over the native, and 13½ per cent. gain of the three-quarters improved blood cows over the half-bred.

If we could get rid of the cattle tick which carries the fever, we could import pure bred cattle from the North without much danger. Until that time, for the general farmer it is best to buy only a good bull, which should be carefully stabled and kept as free from ticks as possible and the native cows bred up. In bringing cattle to the Island we should select animals from a few months to not over 15 months of age. Young cattle can go through the tick fever with small losses if they are carefully stabled a few months and fed green grass largely. With older cattle the chances of loss are greatly increased. It would pay cattle raisers with as many as 10 or 12 head to buy a good bull calf. If the number of cattle kept are so few that he does not feel justified in making such a purchase, he could form a club with his neighbours and they could mutually defray the cost of purchase and transportation of a good bull.

The United States Department of Agriculture will have a skilled veterinarian inspect any cattle purchased by persons in Porto Rico from breeders in the States and see that they meet the requirements and are as represented. A letter just received from the Extension Department of the Wisconsin Experiment Station offers to supervise the purchase of cattle that breeders in Porto Rico may care to make. Wisconsin is the leading dairy state in the Union and the sales of dairy products during the last year reached $275,000,000, while the sale of surplus stock totalled over $3,000,000. They report that at this time there is a surplus of dairy cattle, especially bulls, in that state and they are looking for a market for the same. Good bull calves a month old can be bought from $25 up; bulls of serviceable age at $50 up. These are pure bred animals belonging to the different breeds of dairy cattle. The Extension Department offers to assist breeders in Porto Rico in securing such cattle of the various breeds as they may need. It would pay a great many of our farmers to purchase a bull calf of the breed they prefer and allow the animal to grow up with their herd. *Agricultural Extension Notes, Porto Rico Agricultural Experiment Station.*

ON THE NUTRITION OF THE PEOPLE OF PORTO RICO.

By Dr. Oscar Loew.

The following article on the nutrition of the people of Porto Rico is of considerable value and interest. It indicates that foods containing relatively large quantities of calcium salts are necessary if good health is to be maintained.—Editor.

Man, as well as animal, can only continue in perfect health when nutrition is satisfactory for all organs. In case it is unsatisfactory for a certain period, one or other of the organs as nerves, muscles, liver, kidney, skin, will suffer and will not function normally. This will lead gradually to disease and even death. The disease may be non-infectious as diabetes, albuminuria, neurasthenia, nervousness, asthma, etc.; or, it may be infectious as tuberculosis, rendered possible by predisposition and caused by the imperfect functioning and weakness of the organs, thereby lessening the natural defence of the body.

What constitutes a perfect food? Formerly, too much stress was laid upon a high content of protein or building matter. A nutrient was called "rich" when the protein content was high and "poor" when this was low. This conception has led to an under estimation of fresh vegetables both leaf and root, but just these are very important in furnishing mineral nutrients and elements known as "vitamins."

Every food by itself, except milk, is one-sided and mixtures are, therefore, best. These mixtures must be such as to satisfy all needs of the body, which very often is not the case.

One food is rich in protein or flesh-building properties but poor in lime, as meat, beans, bread; another is rich in carbohydrates or energy-giving properties, as potato, yam, but poor in protein; another again is rich in mineral

nutrients as iron, lime, alkali salts, but poor in protein, and carbohydiates as spinach, cabbage, lettuce. Fruits as apples, pears, oranges, are not only important for their sugar content, but also for their alkali salts of organic acids as citric and malic acid. Vegetables and fruits contain also so-called "vitamins," which in even small amounts are important for health and proper nutrition. Of the mineral nutrients, potassa, soda, lime, magnesia, iron, phosphoric acid, chlorine, some are frequently contained in too small amount in the nutrients. The need of soda is supplied by common salt (chlorid of sodium).

As regards, however, the lime it is only present in sufficient amount in milk, cheese, leaves and roots, but not in meat and seeds as rice and beans. Hence, people like the Porto Rican, subsisting chiefly on rice and beans, are imperfectly nourished. By addition of yam and sweet potato and fruit, alkali salts of organic acids are provided. Yam can furnish also some lime worth while mentioning. Beans and rice contain a relatively considerable amount of potassium phosphate, giving rise to the formation of secondary sodium phosphate in the blood.

By subsisting on food too poor in lime and poor in alkali salts of oiganic acids, not only depression of the bodily strength and of the working power results but also a disposition to tuberculosis, which indeed is found in Porto Rico in an especially large degree. When we compare statistical data from different regions of the globe this fact becomes very evident. Calculated for every 10,000 inhabitants the death-rate from tuberculosis was in Mayaguez during the fiscal year 1919-1920, 37 persons, while in New York in an average of four years only 18, in Berlin (1915) only 17, in Germany (1909) 16, and in Bavaria (1912) 19. In an extraordinary degree tuberculosis dominates in Rio de Janeiro, the death-rate amounting to 47 per every 10,000 inhabitants, average of four years. This is no wonder when we consider the customary nutrition, dried meat, beans and meal of yam being the principal foods.

Let us now compare the statistical data relating to the non-infectious diseases.

	Circulatory Diseases.	Respiratory Diseases.	Nervous Diseases.	Digestive. Diseases.
Mayaguez, 1919-1920	23.8	44.2	3.4	49.0
New York, Mean of 1912, 14, 17, 18.	25.4	25.8	5.2	12.3
Rio de Janeiro, Mean of 1914--17.	25.1	25.0	14.4	45.6
Berlin, 1915	20.5	6 3	8.5	11.2
Bavaria, 1912	19.6	11.8	16.8	19.5

We learn from this table that the number of deaths from respiratory and digestive diseases is greatest in Rio de Janeiro, while in regard to respiratory diseases the number of deaths is smallest in Berlin. In regard to circulatory diseases there are no great differences noted.

It must be recommended to the people of Porto Rico to consume more food rich in lime (calcium salts) and rich in alkali salts of organic acids, such as spinach or cabbage, which are also rich in iron. Plenty of fleshy fruit ought to be consumed between the meals. Deficiency of lime is the cause of numerous diseases. This is not surprising since lime forms a constituent of the nucleus of every animal cell.

A man needs daily an average of one gram lime to replace the normal losses of this element from his body. The lime content of a man of 140 lbs weight amounts to 1½ lbs in the bones and teeth, and 210 grams in the other organs.

One kilo of blood contains		0.06 gram of lime	
,, ,, muscle	,,	0.13	,, ,, ,,
,, ,, milk	,,	1.80	,, ,, ,,
,, ,, leaf vegetable		2.50	,, ,, ,,
,, ,, root	,,	2.04	,, ,, ,,
,, ,, potato contains		0.39	,, ,, ,,
,, ,, sweet fruit	,,	0.34	,, ,, ,,
,, ,, bread	,,	0 32	,, ,, ,,
,, ,, beans	,,	0.25	,, ,, ,,
,, ,, Swiss Cheese	,,	6.23	,, ,, ,,

We see from this that only milk, cheese, leaf and root vegetables are relatively rich in lime. The figures given relate to the fresh state, not to the dry matter.—*Agricultural Extension Notes, Porto Rico Agricultural Experiment Station.*

A DOUBLE-HEADED CALF.

JOURNAL OF THE MINISTRY OF AGRICULTURE.

In the *Journal of Heredity* for May 1921, an illustrated account is given by Dr. W. M. Goldsmith of a living double-headed calf which exists in Kansas. The text and illustrations show that the calf is normally active, but since only two eyes are functional and are located far to the outer sides of the double head, it presents an awkward, staggering gait when moving about, because it cannot see directly forward. The head has two mouths both of which are used in feeding. The lower jaws are trivalent. It is stated that it would be exceedingly interesting to make a minute anatomical study of the specimen under consideration.

Soon after it was born, the calf was sold to a showman, and although an admission of 25 cents was charged to see it, hundreds of people were attracted daily.—*Agricultural Review.—Importance of Agriculture.*

No country, nowadays, which is purely agricultural, can be great; but conversely, no country which is mainly industrial can be peaceful or healthy, and must, consequently, decline. So that it would appear important to maintain a proper balance of agricultural and industrial employment in every country, not merely in respect of the supply of food and raw materials for manufacture—which are generally regarded as the main reasons for developing agriculture—but rather in respect of contented employment and good citizenship.—*Agricultural Review.*

SOME COMMON DISEASES OF HORSES, MULES AND DONKEYS IN BRITISH GUIANA.

By Samuel Bruce.
Doctor of Veterinary Medicine.

Laminitis or Founder in Horses.

Laminitis is an inflammation of the sensitive laminae of the feet, characterized by a general inflammation of the skin and mucous membranes, producing no constitutional disturbances except those dependent upon the local disease, and having a strong tendency, in severe cases, to destruction of the tissues affected.

Causes—From personal observation I do not know that any particular construction of foot or any special breed of horses is predisposed to this disease, neither can I find anything to warrant the assumption that it is in any way hereditary; so that while we may easily cultivate a predisposition to the disease, it does not originate without an exciting cause.

It exists to an extent in those animals unaccustomed to work, especially when they are lymphatic, and in all those that have been previous subjects of the disease, the same rule holds good that we find in so many other diseases, that one attack impairs the functional activity of the affected tissues and renders them more easy to a subsequent inflammation.

The existing causes are many and varied. The most common are concussion, over exertion, exhaustion, ingestion of certain foods, drastic purgatives (*e.g.*) Croton Oil, and lastly but not least of all unsanitary conditions (animal standing in mud.) Where one foot has been blistered, or one limb is incapacitated from any cause, the opposite member, doing double duty, soon becomes exhausted and congestion followed by inflammation results. Where one foot only becomes lamanitic, it is customary to find the corresponding member at a later date, not

always because of sympathy but because one foot had to do the work of two (I cite a case at Pln. Nonpariel about two months ago.)

Symptoms—Usually, the first symptom is the interference with movement. As the lameness develops the pulse becomes fast, full, hard and strikes the finger strongly, the temperature soon rises several degrees above the normal, reaching sometimes 104°—106° F. The respirations are rapid and panting in character, the nostrils widely dilated, and the mucous membranes highly injected. The facial expression is anxious and indicative of the most acute suffering, while the body is more or less bedewed with sweat. At first there may be a tendency to diarrhoea, or it may appear later as the result of the medicines used. The urine is high coloured, scant in quantity, owing to the amount of water eliminated from the skin, instead of the kidneys. The appetite is impaired, sometimes entirely lost but thirst is greatly increased. The affected feet are hot and dry and are relieved as much as possible from bearing weight.

Rapping them with a hammer, or compelling the animal to stand upon one affected member causes intense pain. Any one or more of the feet may become the subject of this disease, although it appears more often in the fore-feet than the hind ones. This is due to the difference of function, that the fore feet are the bases of the columns of support, receiving nearly all of the body weight during progression and consequently most of the concussion, while the hind feet become simply the fulcra of the levers of progressson, and are almost exempt from concussion. When both fore feet are affected the symptoms are well marked. The lameness is excessive and the animal almost immovable. When standing the head hangs low down, or rests upon the manger as a means of support and to relieve the feet, the fore feet are well extended, so that the weight is thrown upon the heels, where the tissues are least sensitive, least inflamed, and most

capable of relief. The hind legs are brought forward beneath the body to receive as much weight as possible thereby relieving the diseased ones.

If progression is attempted which rarely happens voluntarily during the first three or four days, it is accomplished with great pain and lameness at starting, which usually subsides to an extent after a few minutes exercise. During this exercise if the animal happens to step on a small stone or other hard substance, he stumbles painfully and is excessively lame in the offended member for a number of steps, owing to the acute pain which pressure upon the sole causes in the tissues beneath. In the majority of cases I have seen of laminitis in the fore feet the animal persits in standing until he is nearly recovered. In other cases he persistently lies, standing only when necessity seems to compel it, and then for as short a time as possible if the recumbent position is once assumed, the relief experienced, tempts the patient to seek it again, and so we often find him down in greater part of the time. But this is not true of all cases; sometimes he will make the experiment then cautiously guard against its repetition. The most favoured position of the animal when down is on the broadside, with the feet and legs extended.

Prevention—To guard against, or prevent this disease, or to render an unpreventable attack less serious than it otherwise would be, calls for the highest practice of the healing art. In a disease so prone to result from the simplest causes, especially when the soundest judgment may not be able to determine the extent of the disease—resisting powers of the tissues which are liable to be affected, or of what shall in every instance constitute an over-excitement, it is not strange that horse owners find themselves in trouble from unintentional transgression. If the disease was dependent upon specific causes, or if the stability of the tissues was of a fixed or more nearly determinate quality, some measures might be instituted that may prove generally preventive. But the predisposing causes are

common conditions and often cannot be remedied. That which is gentle work in one instance may incite disease in another. That which is food to-day may to-morrow prove disastrous to health. Finally, necessary medical interference, no matter how judicious, may cause a more serious complaint than that which was being treated. There are some general rules to be observed that will in part serve to prevent the development of an unusual number of cases. Fat animals should, under no circumstances, have hard work. If the weather is extremely hot, all horses should have but slow, gentle labour until they become inured to it, Young horses should have moderate work especially when taken from pasture, and dirt roads to city streets, for increased concussion, changed hygienic conditions, and artificial living readily become active causes of the disease under these circumstances.

Treatment—Three to four ounces of saltpetre in a pint of water, repeated every six hours, is the proper dose. The laminitis frequently subsides within a week. These large doses may be continued for a week without danger, and under no circumstances have I seen the kidneys irritated to excess or other unfavourable effects produced. The feet should be kept in a tub of cold water, unless the animal is lying down, when swabs are to be used and wetted every hour with cold water. Aconite may be given in ten drop doses, in conjunction with the niter every two hours for 24 hours. Aconite tends to calm the excited heart. The use of cathartics is dangerous causing diarrhoea. At the end of the fifth or sixth day if recovery does not take place, apply a stiff cantharides blister around the coronet and omit the niter for 48 hours. When the blister is well set, the feet may again receive wet swabs. If one blister does not remove the soreness it may be repeated, or the actual cautery applied.

Strangles in Mules at La Penitence a Year Ago.

It appears as a fever lasting for a few days, with formation of matter or pus, in the air tubes and lungs,

and frequently the formation of abscesses in various parts of the body, both near the surface and in the internal organs. It usually leaves the animal after convalescence perfectly healthy and as good as it was before, but sometimes leaves it a roarer, or is followed by the development of deep-seated abscesses, which may prove fatal.

Causes—The cause of strangles is infection by direct contact with an animal suffering from the disease, or indirectly through contact with the discharges from an infected animal, or by means of the atmosphere in which an infected animal has been. There are many causes which render some animals much more subject to contract the disease than others. Early age, which has given it the proper name of colt-ill, offers many more subjects than the later peroids of life do, for the animal can contract the disease but once and the large majority of adult and old animals have derived an immunity from previous attacks. At 3, 4 or 5 years of age, the colt which has been at home, if it fails to contract it there, is sold and shipped in foul, undisinfected railway cars, or deck of a ship, where it meets many opportunities of infection. If it escapes so far, it reaches the time for heavier work and daily contact on the streets of towns, or large cities, with numerous other horses and mules some of which are sure to be the bearers of the germs of this or some other infectious disease and at last it succumbs. The period of eruption of the last permanent teeth, or the end of the period of the development from the colt to the horse, (mule, ass) at which time the animals usually have a tendency to fatten and be excessively full-blooded also seems to be a predisposing period for the contraction of this as well as other infectious diseases.

Symptoms—The animal at first is a little sluggish if used, or when placed in a stable is somewhat dejected, paying but moderate attention to the various disturbing surroundings. Its appetite is somewhat diminished in many cases, while in some cases the animal eats well throughout. Thirst is increased, but not a great deal

of water is taken at one time. If a bucket of water is placed in the manger the patient will dip its nose into it and swallow a few mouthfuls, allowing some of it to drip back, and then stop, to return to it in a short time. The coat becomes dry and the hair stands on end. At times there are chills of one or the other leg, the fore quarters, or hind quarters or in severe cases of the whole body, with trembling of the muscles and dryness of the skin. On examination of the eyes and mouth the membranes are reddened to a bright rosy color. The pulse is quickened, and the breathing may be somewhat increased. At the end of a couple days a cough is heard and a discharge begins to come from the nostrils. This discharge is at first watery, it then becomes thicker, somewhat bluish in color, and sticky, and finally it assumes the yellowish color of matter and increases greatly in quantity. At the outset the animal may sneeze occasionally and a cough is heard. The cough is at first repeated and harsh, but soon becomes softer and moist as the discharge increases. Again the cough varies according to the source of the discharge, for in light cases this may be only a catarrh of the nasal canals, or it may be from the throat, the wind-pipe, or the air-tubes of the lungs, or from the lungs themselves. According to the organ affected the symptoms and character of cough will be similar to those of laryngitis, bronchitis, or lung fever caused by ordinary cold. Shortly after the discharge is seen a swelling takes place under the jaw, or in the inter-maxillary space. This is at first puffy, swollen, somewhat hot and tender, and finally becomes distinctly so, and an abscess is felt, or having broken itself the discharge is seen dripping from a small opening. When the discharge from the nostrils is fully developed the fever usually disappears and the animal regains its appetite, unless the swelling is sufficient to interfere with the function of the throat, causing pain on any attempt to swallow. At the end of four or six days the discharge lessens, the soreness around the throat diminishes, the horse regains its appetite, and in two

weeks has regained his usual condition. Old and strong horses and mules may have the disease in so light a form that the fever is not noticeable, they may continue to eat and perform their ordinary work as usual and no symptom may be seen beyond a slight discharge from the nose and a rare cough which is not sufficient to worry any but the most particular owner. But, to the other hand, the disease may assume a malignant form or become complicated so as to become a more serious disease, and even prove fatal in many cases. Inflammation of the larynx and bronchi, if excessive, will produce violent, harsh coughing, which may almost asphyxiate the animal. The large amount of discharge may be mixed with air by the difficult breathing, and the nostrils, the front of the animal, manger, and surrounding objects become covered with a white foam. The inflammation may be in the lung itself, and cause the animal to breathe heavily, heave at the flanks, and show great distress. In this condition marked symptoms of fever are seen, the appetite is lost, the coat is dry, the annimal stands back in its stall at the end of the halter strap with its neck extended and its legs propped apart to favor breathing. This condition may end by resolution, leaving the animal for some time with a severe cough, or the animal may die from the choking up of the lungs. The swelling under the jaw may be excessive, and if the abscess is not opened it burrowes toward the throat or to the side and causes inflammation of the parotid glands and breaks in annoying fistulas at the sides of the throat and even up as high as the ears. Roaring may occur either during a moderately severe attack from inflammation of the throat, or at a later period as the result of continued lung trouble. Abscesses may develop in other parts of the body, in the poll, in the withers, or in the spaces of loose connective tissues under the arms, in the fold of the thigh, and in the testicles. During the course of the disease or later when the animal seems to be on the road to perfect recovery, abscesses may form in the internal organs and produce symptoms characteristic of disease

of those parts. Roaring, plunging, wandering in a circle, or standing with the head wedged in a corner of the stall indicate the collection of matter, or pus in the brain. Sudden and severe lung symptoms without previous discharge, point to an abscess between the lungs, colic, which is often continuous for days, is the result of the formation of an abscess in some part of the abdominal cavity, usually in the mesentery.

Treatment—Ordinary light cases require but little treatment beyond diet, warm bran mashes, and protection from exposure to rain. If the fever is excessive the animal may receive small quantities of Glauber salts (handful three times a day) as a laxative, bicarbonate of soda or niter in one dram doses every two hours, and small doses of antimony, iodide of potash, or quinine. Steaming the head with the vapor of warm water poured in a bucket containing a teaspoonful of eucalyptus oil, will allay and soothe the inflamed mucous membrane, and greatly ease the cough. The swelling of the glands should be promptly treated by bathing with warm water and linseed meal poultices, and as soon as there is any evidence of the formation of matter, or pus it should be opened. Prompt action in this will save serious complications. Blisters and irritating liniments should not be applied to the throat. When lung complications show themselves, the animal should have mustard applied to the belly and to the sides of the chest. When convalescence begins great care must be taken not to expose the animal to rain, which may bring on relapses, and while exercise is of great advantage, it must not be turned into work until the animal has entirely regained its strength.

Sprung knees in Donkeys.

It consists in such an alteration in the direction and articulation of the bones which form the various carpal or knee joints that instead of forming a vertical line from the lower end of the forearm to the cannon bone they are so united that the knee is more or less

bent forward, presenting a condition due to the retraction of two of the principal muscles by which the cannon bone is flexed.

Cause—The flexion of the knee may be a congenital deformity and have continued from the foaling of the animal; or, like clubfoot, it may be the result of heavy labour which the animal had been compelled to perform at too early an age. It may be due to other diseases existing in parts below the knee-joint.

Symptoms—This change of direction largely influences the movement of the animal by detracting from its firmness and practically weakening the entire frame, even to the extent of rendering him insecure on his feet and liable to fall. The condition of weakness is sometimes so pronounced that he is exposed to fall even when standing at rest and unmolested, the knees being unable even to bear the portion of the weight of the frame which belongs to them. This results in another trouble—that of being unable to keep permanently upright. He is apt to fall on his knees, and by this act becomes presently a sufferer from the lesion known by the term of broken knees.

Treatment—Whatever may be the originating cause of this imperfection, it detracts very largelv from the usefulness and value of an animal, disqlualifying him for ordinary labor, and wholly unfitting him for service. If, however, the trouble is known from the start, and is not the result of congenital deformity or weakness of the kneejoint, or secondary to other diseases, rest, with fortifying frictions, may sometimes aid in strengthening the joints and the application of blisters on the posterior part of the knee from a short distance above to a point a little below the jòint, may follow with some satisfactory results; but with this trouble, as with knuckling fetlocks, the danger of relapse must be kept in mind as a contingency always liable to occur.

ATTENDANCES AT THE DISTRICT GARDENS

Year.	Bourda.	Belfield, E. Coast.	Stanleytown, New Amsterdam.	Suddie, Essequibo.	Den Amstel.	Houston, E. Bank.	Wakenaam.	Total Attendances.
1912 ...	5,514	4,395	3,302	2,100	2,544	2,156	718	21,729
1913 ...	5,156	4,535	2,519	3,399	2,568	1,836	1,319	21,332
1914 ...	4,243	3,869	2,443	3,025	1,791	1,653	1,533	18,577
1915 ...	1,123	1,006	769	59	503	339	401	4,200
1916 ...	4,705	1,161	1,510	225	623	2,251	1,297	12,026
1917 ...	4,991	2,820	1,366	3,297	1,186	2,564	1,663	17,086
1918 ...	4,834	3,081	1,653	2,671	2,162	2,790	2,067	19,258
1919 ...	4,769	2,425	1,582	2,798	1,851	2,480	1,556	17,461
1920 ...	6,285	2,312	1,665	2,525	2,532	3,228	2,148	20,695
1921 ...								
1st Quarter	1,761	639	502	307	673	829	490	5,201
2nd Quarter	1,790	554	410	1,408	549	812	430	5,993
3rd Quarter	1,210	289	350	405	315	499	306	3,374
4th Quarter	910	486	380	509	412	399	384	3,480

Meteorological Data 1921.

BOTANIC GARDENS, GEORGETOWN.

1921. MONTHS.	Rainfall.	Number of Days of Rain.						Evaporation.
	Inches.	Under .10 in.	.10 to .50 in.	.50 to 1.00 in.	1.00 to 2.00 in.	Above 2.00 in.	Total Days.	Inches.
January	4.81	9	7	2	1	...	19	4.35
February	.48	...	3	...	...	...	03	5.30
March	3.45	5	10	1	...	...	16	5.71
April	8.56	8	8	4	..	1	21	4.65
May	1.20	5	3	...	...	...	8	6.60
June	21.15	4	14	5	3	3	29	2.90
July	12. 73	3	11	2	7	...	23	4.15
August	3·52	7	6	2	...	...	15	5.44
September	3.42	5	7	2	...	...	14	5.02
October	8.87	6	5	2	4	...	17	4.41
November	20.74	6	8	5	2	4	25	3.06
December	15.31	1	12	9	3	1	26	3.27
TOTALS	104.24	59	94	34	20	9	216	54.86

The rainfall during 1921 was characterised by being well above that of a normal year (See Meteorological Report for the year 1916 p. 105.) It varied in the following respects:—January, February and March were unusually dry. The precipitation in April was normal. May was ten inches below the average which constitutes a record for this month.

The rainfall during June and July was slightly above the average and August was fully 3 inches below it. September agreed with the standard. The prospects of a comparatively dry year were marred by a precipitation of five inches above the average in October, nearly ten inches excess in November and an excess of four inches in December.

Below is a table showing the day of the year 1921 during which the greatest precipitation of rain took place and the amount thereof, also the day on which the highest grade temperature was recorded. These figures refer to Georgetown (Botanic Gardens), New Amsterdam (Botanic Gardens) and Onderneeming (Industrial School). No temperature records were kept at Morawhanna (Police Compound).

Stations.	Wettest Day.	Rainfall.	Hottest day.	Temperature.
Botanic Gardens Georgetown.	24th Nov.	3·64	8th Sep.	89·5
New Amsterdam.	14th Apl.	2·37	14th Nov.	97 5
Onderneeming.	18th Dec.	3·04	4th Feby.	90·0
Morawhanna.	17th Apl.	4·64	...	...

AIR TEMPERATURE AND HUMIDITY IN THE SHADE, BOTANIC GARDENS, GEORGETOWN, 1921.

MONTHS.	Air Temperature.			Humidity.
	Maximum.	Minimum.	Mean.	Mean.
January	83·7	74.9	79.3	78.6
February	84.6	74 7	79.6	73.1
March	85.0	75.0	80,0	78.5
April	84.7	76.0	80,3	79.1
May	85.0	78.4	81.7	72.1
June	84.6	74.6	79.6	82.9
July	84.7	74.0	79.3	82.6
August	86.0	75.6	80.8	78.3
September	86.8	76.1	81 4	79.8
October	85.6	75.8	80.7	79.4
November	84.5	75.4	79.9	82.4
December	84.1	74.4	79.2	81.8
Mean	84.9	75.4	80.1	79.0

EXPORTS OF AGRICULTURAL AND FOREST PRODUCTS

Below will be found a list of the Agricultural and Forest Products of the Colony exported during 1921. The corresponding figures for the two previous and the average for the four years prior to that are added for convenience of comparison.

Product.	*Average 1915-18.*	*1919.*	*1920.*	*1921.*
Sugar, tons ...	106,445	83,139	83,765	108,270
Rum, gallons ..	3,778,871	4,342,769	1,772,178	2,228,164
Molasses, gallons ...	89,550	171,249	420	204
Cattle-food (Molascuit tons)	2,105	2,023	1,783	1,707
Cacao, cwts. ...	276	85	216	None
Citrate of Lime, cwts.	205	388	571	439
Lime Juice, gals. ...	11,035	10,238	6,001	4,175
Essential Oil of Limes, gals.	180	326*	484*	544
Coconuts, thousands	1,787	4,693	2,621	2,760
Copra, cwts. ...	1,932	1,367	296	783
Coconut Oil, gals. ...	24,333	9,129	20,093	15,934
Coffee, cwts. ...	3,277	8,362	3,642	3,617
Kola-nuts, cwts. ...	25	None	9	None
Rice, tons ...	44,450	6,942	8,094	3,026
Ricemeal, tons ...	197	None	None	None
Cattle, head ...	621	4	4	None
Hides, No. ...	3,503	7,562	5,985	12,201
Pigs, No. ...	702	None	None	47
Sheep, head ...	27	None	66	72
Balata, cwts. ...	12,601	12,546	9,595	1,214
Charcoal, bags ...	49,562	41,380	47,620	51,203
Firewood, Wallaba, etc., tons ...	8,459	6,846	4,852	6,475
Gums, lbs. ...	322	2,338	3,521	8,792
Lumber, cub. ft. ...	223,438	234,882	297,763	170,170
Railway sleepers, No.	11,614	5,458	14,704	10,112
Rubber, cwts. ...	129	158	182	14
Shingles, thousands	2,655	3,277	2,589	1,890
Timber, cub. ft. ...	83,763	101,383	68,200	121,395

* In Vol. XIV. No. 1 January 1921 of this Journal the export of Essential Oil of Limes for 1919 was given as 826 gallons, it should have read 326 gallons ; likewise the export of this same product for 1920 was given as 817 gallons, it should have read 484 gallons.

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SCIENCE AND AGRICULTURE.

The well-worn controversy concerning the practical application of scientific research still commands the attention of the general public.

Much has been said and written, much criticism levelled and replied to on both sides and—some progress has been attained. A better understanding now exists and some real measure of harmony pervades.

It is not an easy subject. On the one side we have the scientific worker—an individual usually wholly occupied with his intricate problems and seldom possessing much sympathy with the practical viewpoint. On the other we have the person who deals entirely in things practical and by his labours and transactions gains a direct remuneration and material benefit. Can he be expected to fully appreciate the scientist or to understand him?

The war did much to produce a clearer viewpoint for both parties. The combatants (the British ones) suddenly became aware that the man of science was capable of producing means and methods whereby the destruction of the enemy became a simpler and safer affair and that existence both in the trenches and elsewhere could be made infinitely more comfortable and healthier.

The scientist, on his side, at once took the fullest opportunity of thus demonstrating his powers and to-day we may well be thankful therefor.

The application of science to agriculture is better appreciated by the farmer of to-day, yet much remains to be accomplished.

We print in this issue an exceedingly valuable paper by that well known agricultural scientist Dr. Augustus Voelcker, which clearly sets forth the part which science plays in present day agriculture—its attainments, the possibilities of its further developments.

We strongly recommend to our readers a perusal of this interesting contribution.

WHITE-ANT-PROOF WOOD FOR THE TROPICS.

By T. E. Synder, *Specialist in Forest Entomology, Bureau of Entomology, U. S. Department of Agriculture.*

It is well known that white ants or termites are extremely destructive in the Tropics and that the woodwork of buildings and furniture must be constructed either of woods naturally resistant to attack or of woods chemically treated to prevent attack and rapid destruction.

Foreign manufacturers advertise "ant-proof" furniture for South American trade; American manufacturers have, as yet, not seriously competed.

Wood-pulp products such as composition, ply and laminated wall boards, manufactured in the United States, also demand chemical treatment before they can be used in the Tropics.

Rather discouraging to American manufacturers, is the fact that due to spoiling the wood for fine finishing, cabinet woods cannot be treated by the usual effective chemicals. A solution is given in the use of ant-proof woods imported from South America and other tropical countries as veneers glued upon cores of cheap American woods chemically treated. This well-known expedient is satisfactory, but there are other solutions of the problem.

A number of woods grown in the United States are very resistant to attack by white ants. Hence, since many of these woods are suitable for use as veneers, it is not necessary to import timber from the Tropics.

Furthermore, there is a chemical treatment for cabinet woods that while it will somewhat darken the wood, if the wood is properly treated, permits shellac or varnish to adhere, and a suitable finish can be obtained. Wood treated with this chemical is both white-ant-resistant and moisture-proof. The cost of this treatment is justified by this double effect and the fact that cabinet woods impregnated with this chemical can be advertised as white-ant-proof. Wood-pulp products also can be rendered white-ant-proof by adding poisons in the process of manufacture.

Naturally Resistant Woods.

In 1912 the Branch of Forest Fntomology of the Bureau of Entomology, U.S. Department of Agriculture, began a series of tests of the relative effectiveness of treatments with chemical wood preservatives against attack by white ants at a field station at Falls Church, Va. In connection with these experiments, other service tests of the relative resistance of various native and tropical untreated woods to attack by white ants were begun in 1913.

The preliminary results of these tests, which are as yet incomplete and not conclusive, give some data of value. Certain species of wood appear to be naturally highly resistant to attack by white ants. This is not due to the element of hardness, since these insects will attack the hardest known wood, Lignum-vitae, but due to the

presence in the wood of substances such as oils, alkaloids, etc., which are repellent or distasteful to white ants.

Normally the wood of pines is most susceptible to attack by white ants, but in case of certain pines with an extremely resinous heartwood, such as the "fatwood" of longleaf pine (*Pinus palustris*) of the southern United States, this is immune to attack by white ants; the excess of resin is a preventative. There is also some inherent principle in the heartwood of the red cedars (species of *Juniperus*) which renders it distasteful to white ants.

Species of native woods which might be used as veneers over chemically treated woods, or as ply or laminated woods, are listed in Table I, with their distribution in the United States, and their relative resistance to attack by white ants.

A few species valuable or which might prove useful for other purposes are also listed in this table.

CHEMICAL TREATMENTS FOR FINISHED FOREST PRODUCTS.

The treatment for cabinet woods is impregnation with chlorinated naphthalene—a crystalline wax—by placing it in open vats of the wax, at a temperature of from 220 to 240° F., without previous drying of the wood[1]. The wood remains in the vats for periods varying with the dimensions of the wood; wood of $\frac{1}{2}$ inch thickness requires but 15 minutes.

After removing the wood from the vats it should be carefully wiped off with cloth. The resultant colour will be somewhat darker than the colour of the untreated wood; care must be exercised in thoroughly cleaning the surface of the wood to insure the proper adherence of shellac or varnish.

The amount of wax taken up in the above treatment will vary with the different species of woods—whether they are open-pored or not—and according to the con-

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1 Process devised by the Western Electric Company of New York N. Y.

dition of the wood to be treated. A representative group of both softwoods and hardwoods were treated with chlorinated naphthalene for our tests. This treatment renders the wood both white-ant-proof and moisture-proof to a marked degree. When treated with chlorinated naphthalene these sample sections of North American hardwoods, susceptible to attack if untreated, were not attacked, after burial in the ground for over three years with logs infested with white ants or termites (*Reticulitermes* spp.) in Virginia. After this severe test in the ground these treated wood compared favourably with untreated teak and mahogany as to general condition.

Similar samples of woods treated with paraffin wax were readily attacked by white ants and also suffered decay.

CHEMICAL TREATMENTS FOR CRUDE FOREST PRODUCTS.

Construction timbers or other timber which is to be in contact with the ground should be impregnated with coal tar creosote, which is a permanent preventative against attack by our native white ants or termites. Coal tar creosote has many properties which would recommend its use in this respect, for it is also a fungicide, and, being insoluble in water, will not leach out in wet locations. These requirements furnish objections to many chemicals that otherwise are very effective insecticides.

The various methods of superficially treating timber, as by charring, by brushing or by dipping with various chemical preservatives, among which are coal-tar creosotes, carbolineums, etc., have proven to be temporarily effective in preventing attack if the work is thoroughly done.

If the wood is not in contact with the ground, impregnation treatments with bichlorid of mercury and zinc chlorid are effective. The mercury and zinc in this form are both soluble in water.

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[1] White pine *(Pinus strobus)*, black walnut, sweet birch (*Betula lenta*), chestnut, white oak (*Quercus alba*), red oak *(Quercus rubra)*, sweet gum *(Liquidambar styraciflua)* mahogany *(Swietenia mahogoni)*, sugar maple (*Acer saccharum*), white ash (*Fraxinus americana*).

The last named chemicals would be suitable treatments for cheap perishable woods to be used as the core, over which ant-proof veneers could be glued.

CHEMICAL TREATMENTS OF WOOD PULP PRODUCTS.

In case of ply or laminated wall "boards" made of wood pulp, these boards may be made highly resistant to attack by white ants by adding poisons during the process of manufacture. Such poisons include solutions of bi-chlorid of mercury, carbolic acid, etc. Coal-tar creosote can be added where the brown stain and odour which are imparted to the board are not objectionable.

While white ants of the Tropics are more numerous and, as a rule, more destructive than those native to the United States, it is evident that if treated or untreated woods are resistant to attack by our native white ants (*Reticulitermes* spp.) after a severe five-year test in the ground, they will not readily be attacked when above ground by white ants of the Tropics; especially since our native white ants (*Reticulitermes* spp.) wherever they occur throughout the world are among the most destructive species of wood ants.—*Journal of Economic Entomology.*

In a note on Lord Howe island, which is situated three hundred miles to the east of Australia, *Nature* calls attention to the regrettable disappearance of the once-rich ornithological fauna. The chief cause in this reduction of the bird life has been the increase in the number of rats. These vermin were accidentally introduced, and 'the birds' paradise of two years ago has been reduced to a veritable wilderness beyond all hope of recovery.'

KENNETH DENISON REID.

BORN SEPTEMBER 3RD, 1887—DIED JANUARY 17TH, 1922.

IT is with the deepest regret that we announce the death of the 1st Assistant Analyst of this Department. Kenneth Reid, after being educated at Queen's College, joined the Laboratory staff in 1905 as a Clerical and Laboratory Assistant. In 1907 he was appointed 2nd Assistant Analyst and in 1915 Scientific Assistant. He became 1st Assistant Analyst on the death of John Williams in 1917. Besides these attainments he was in charge of the science teaching at Queen's College and acted as Science Lecturer from 1913—1914. He acted in a similar capacity in 1915. During 1920 he was responsible for several numbers of the Journal of the Board of Agriculture.

Of a quiet and studious disposition, eminently possessed of those several sterling characteristics which are essential qualities of the true gentleman, Reid was held in esteem by all those with whom he came in contact. Those who knew him intimately found him an appreciative and genial companion, a true and trusty friend.

He leaves a widow and infant to mourn his loss and to them we extend our sincerest sympathy in their sad and untimely bereavement.

G.E.B.

THE SCALE INSECTS OF BRITISH GUIANA.

By G. E. Bodkin, B.A., Dipl. Agric. (Cantab) F.E.S.

Department of Science and Agriculture, British Guiana.

In the Journal of the Board of Agriculture of British Guiana Vol. VII., No. 3, January, 1914, there appeared a previous paper on this same family of insects. Fifty-one species were then recorded and a general account of their economic importance in the Colony was given; accounts were also set forth concerning their natural enemies and methods of artificial control.

In the Bulletin of Entomological Research, Vol. vii., Part 1, August, 1917, a further paper appeared. Sixty-seven species were then recorded and a condensed account of the natural enemies was also given.

In the present paper ninety-four species are recorded. A number of these further twenty-seven species are new to science. In such instances the publication in which the descriptions of these new species appeared is noted in the text.

Only notes concerning those species which have been collected since the 1914 paper are included here.

The majority of the species recorded have been collected by the author. Exceptions to this are noted in the text. Some interesting material has recently been collected by Mr. Abraham whilst attached to the Survey of the Rupununi Cattle Trail, and by Mr. Harold Morrison, of the United States' Bureau of Entomology.

The greater number of identifications have been made through the agency of the Imperial Bureau of Entomology by Professor Robert Newstead, F.R.S. The material collected by Mr. Morrison was identified in the United States of America. Dried or microscopical preparations of a number of these further twenty-seven species are preserved in this Laboratory.

It is hoped that this paper may arouse further interest in this important insect family so that fresh species may be collected and our present somewhat fragmentary knowledge materially increased.

FAMILY COCCIDAE.

Sub-family Monophlebinæ.

1. *Llaveia abrahami.* Newst. Apparently a rare species. Primarily observed by Mr. A. A. Abraham at the Government Experimental Station, Issororo, North Western District. It was found in this instance, in an indentation of the bark of the Native Rubber tree *Sapium Jenmani.* A new species described by Prof. R. News'ead in the Bulletin of Entomological Research, Vol. VII., Part 1.

SUB FAMILY DIASPINÆ.

2. *Chionaspis citri.* Comstock.

3. *Howardi biclavis.* Comstock.

4. *Howardi biclavis detecta.* Maskell.

5. *Diaspis boisduvali.* Signoret.

6. *Diaspis echinocacti optuniae.* Ckll.

7. *Aulacaspis rosae.* Bouche.

8. *Hemichionaspis minor.* Mask.

9. *Hemichionaspis aspisdistrae.* Sign. Collected by Harold Morrison of the United States Bureau of Entomology. Species determined by E. R. Sasscer, also of the United States Bureau of Entomology. Host plant *Nephrclepis* sp. Botanic Gardens, Georgetov 3Sept.—Oct. 1918.

Collec *Pinaspis buxi.* Bouche.

11. *Aspidiotus cydoniae.* Comstock.

12. *Aspidiotus destructor.* Signoret.

13. *Aspidiotus diffinis.* Newstead.

14. *Aspidiotus sacchari.* Ckll.

15. *Aspidiotus rapax.* Comst.

16. *Aspidiotus (chrysomphalus) umboniferus.* Newst. A new species described by Prof. R. Newstead in the Bulletin of Entomological Research Vol. X., Part ii., January, 1920. An uncommon species taken on the leaves of a tree (Lecythis sp.) growing in a small Indian Settlement at Ayaiia, Ituribisci, Essequibo. Collected by G. E. Bodkin 6.10.18.

17. *Aspidiotus palmae.* Morgan and Cockerell. Collected by Harold Morrison and G. E. Bodkin on a species of ornamental palm, Botanic Gardens, Georgetown, Sept. 1918. Described by Prof. R. Newstead. The material collected by H. Morrison was identified by H. F. Dietz, United States Bureau of Entomology. A fairly common species.

18. *Aspidiotus secretus.* Cockerell. Collected by Harold Morrison and G. E. Bodkin on a large species of Bamboo, Botanic Gardens, Georgetown, British Guiana, Sept. 1918. The species was common on the sheating basis present at each segment of the Bamboo. Determined by Prof R. Newstead.

19. *Aspidiotus camelliae.* Sign. Collected on bark of the common maritime tree known as Courida (*Avicennia nitida.*) Not a common species. Collected by G. E. Bodkin, Kitty seashore, February, 1919. Determined by Prof. R. Newstead.

20. *Aspidiotus lataniae.* Sign. On Sapodilla. (Achras Sapota). Collected by Harold Morrison, Botanic Gardens, Georgetown, Sept. 1918. Species determined by E. R. Sasscer. United States Bureau of Entomology. Collected also by G. E. Bodkin on Sea Grape. Kitty Village. March 1921.

21. *Aspidiotus subsimilis anonae.* Houser. Collected on *Macrolobium acaciaefolium.* Botanic Gardens, Georgetown. Sept, 1918.

22. *Aspidiotus cyanophylli.* Sign. Collected on Malacca apple. Botanic Gardens, George-

town, by Harold Morrison Sept. 1918. Species determined by Harold Morrison.

23. *Aspidiotus (Chrysomphalus) apicatus.* Newst. Described by Prof. R. Newstead in the Bulletin of Entomological Research. Vol X. Part ii. January 1920. Collected on Courida (*Avicennia nitida*) by G. E. Bodkin and H. Morrison. Enmore Sea Front, East Coast, Demerara, Sept. 1918.

24. *Morganella longispina.* Ckll.
As noted in my previous papers on the Coccidae of British Guiana this species was recorded from here in 1889 by A. E. F. Morgan. I have lately collected it (8. 9. 19.) in the Botanic Gardens, Georgetown, on Papaw. The identification was made by Prof. R. Newstead and a record of its collection made in the Bulletin of Entomological Research. Vol. X. Part ii. January 1920.

25. *Pseudaonida fossor.* Newst.

26. *Selenaspidus articulatus.* Morgan.

27. *Chrysomphalus aonidum.* Linn.

28. *Chrysomphalus aurantii.* Maskell.

29. *Chrysomphalus biformis.* Ckll.

30. *Chrysomphalus dictyospermi.* Morgan.

31. *Chrysomphalus dictyospermi pinnulifera.* Mask.

32. *Chrysomphalus dictyospermi arecae.* Newst.

33. *Chrysomphalus personatus.* Comst.

34. *Chrysomphalus erythraspidis.* Newst.

35. *Chrysomphalus apicatus.* Newst.

36. *Odonaspis pencillata.* Green.

37. *Pseudoparlatoria ostreata.* Ckll.
Collected on Guava. Botanic Gardens, by H. Morrison. Species determined by E. R. Sasscer. United States Bureau of Entomology.

38. *Lepidosaphes beckii.* Newn.

39. *Lepidosaphes pinneaformis.* Bouche.

40. *Lepidosaphes lasianthi.* Green.

Collected on Crotons by H. Morrison. Botanic Gardens, Georgetown. Species determined by E. R. Sasscer, U. S. Bureau of Entomology.

41. *Ischnaspis longirostris.* Douglas.

42. *Parlatoria pinnaeformis.* Bouche.

43. *Parlatoria proteus.* Curt.

Collected by H. Morrison on Billbergia sp. Botanic Gardens, Georgetown. Sept, 1918.

44. *Parlatoria crotonis.* Ckll.

Collected on Crotons, Botanic Gardens, Georgetown, Sept, 1918. Species determined by E. R. Sasscer, United States Bureau of Entomology.

SUB-FAMILY *Ortheziinae.*

45. *Orthezia praelonga.* Douglas.

46. *Orthezia praelonga.* Douglas.

47. *Asterolecanium bambusae.* Bdv.

SUB-FAMILY *Dactylopiinae.*

48. *Asterolecanium fimbriatum.* Fonsc.

49. *Asterolecanium pustulans.* Ckll.

50. *Lecaniodiaspis dendrobii.* Douglas.

51. *Ceroputo barberi.* Ckll.

52. *Pseudococcus citri.* Risso.

53. *Pseudococcus nipae.* Mask.

54. *Pseudococcus virgatus.* Ckll.

55. *Pseudococcus sacchari.* Ckll.

56. *Pseudococcus inquilinus.* Newst.

This species was collected during the Survey of the Rupununi Cattle Trail in March, 1919, by A. A. Abraham. Species of host plant unknown. The insects were enclosed by ants in small paper-like nest. Species described by Prof. R. Newstead in the Bulletin of Entomological Research. Vol. X. Part ii. January, 1920.

57. *Pseudococcus bromeliae.* Bouche.
Collected from pineapples by H. Morrison, Sept, 1918, species determined by collector.

SUB-FAMILY *Tachardiinae.*

58. *Tachardia lacca.* Kerr Sub-family.

59. *Tachardia bodkini.* Newst.

SUB-FAMILY COCCINAE.

60. *Pulvinaria pyriformis.* Ckll.

61. *Pulvinaria simulans.* Ckll.

62. *Pulvinaria flavicans.* *Mask, var. formicicola* Newst.

63. *Pulvinaria elongata.* Newstead.

64. *Pulvinaria brevicornis.* Newstead.
Collected on twigs of the maritime plant known locally as Courida (*Avicennia nitida*) by G. E. Bodkin 22.6.1917. Turkeyen, East Coast, Demerara, British Guiana. This species was described by Prof. R. Newstead in the Bulletin of Entomological Research, Vol, X. Part ii. January, 1920.

65. *Pulvinaria broadwayi var echinopsidis.* Newst. Collected on *Echinopsis latiflora.* by H. Morrison and G. E. Bodkin, Sept., 1918. Botanic Gardens, Georgetown, British Guiana. This species was described by Prof. R. Newstead in the Bulletin of Entomological Research, Vol. X., Part ii., January, 1920.

66. *Pulvinaria psidii.* Mask.
Collected on "Ackee" (*Blighia sapida*) by H. Morrison Sept., 1918, Botanic Gardens, Georgetown, British Guiana. Species determined by the collector.

67. *Lichtensia litoralis.* Newstead.
Collected on an undetermined species of plant. Courantyne Coast, Berbice, British Guiana, by G. E. Bodkin, 29.1.19.

68. *Ceroplastes denudatus.* Ckll.

69. *Ceroplastes floridensis.* Comst.

70. *Ceroplastes cirripediformis.* Comst.

71. *Ceroplastes avicenniae.* Newst.

72. *Vinsonia stellifera.* Westw.

73. *Pseudokermes marginatus* Newst.

Collected during the Survey of the Rupununi Cattle Trail, 28.2.19, by A. A. Abraham on *Nectandra.* Species described by Prof. R. Newstead in the Bulletin of Entomological Research, Vol. X., Part ii., January, 1920.

74. *Eucalymnatus chelonoides.* Newst.

75. *Eucalymnatus perforatus.* Newst.

76. *Eucalymnatus tesselatus.* Sign.

77. *Eucalymnatus decemplex.* Newst.

Collected on leaves of *Lecythis* s.p Ayaria, Ituribisci, Essequebo, British Guiana, by G. E. Bodkin, 6.10.1918. Species described by Prof. R. Newstead in the Bulletin of Entomological Research, Vol. X., Part ii., January, 1920.

78. *Coccus aequalis.* Newst.

79. *Coccus hesperidum.* Linn.

80. *Coccus impar.* Ckll.

81. *Coccus mangiferae.* Green.

82. *Coccus viridis.* Green.

83. *Coccus wardi.* Newst.

84. *Akermes quinquepori.* Newst.

85. *Platysaissetia montrichardiae.* Newst.

Collected on the common local plant known as "Mucca-mucca" (*Montrichardia aculeata*) by G. E. Bodkin, Ikuraka lake, Ituirbisci Creek, Essequebo, British Guiana, 2.3.1917. In this locality the species is fairly common. I have not observed it in other districts, however. The species was described by Prof. Newstead in the Bulletin of Entomological Research, Vol. X., Part ii., January, 1920.

86. *Saissetia begoniae.* Douglas.

87. *Saissetia hemisphaerica.* Targ.

88. *Saissetia nigra.* Nietn.

89. *Saissetia oleae.* Bern.

90. *Saissetia hurae.* Newst.

91. *Saissetia scutata.* Newst.

92. *Lecanium (Eulecanium) deformosum.* Newst.
Collected during the Cattle Trail Survey by A. A. Abraham. Species of host plant unknown. The insects were enclosed by ants (Acromyrmex sp.) in small paper-like nests. Species described by Prof. Newstead in the Bulletin of Entomological Research, Vol. X., Part ii., January, 1920.

93. *Lecanium inquilinum.* Newst.
Collected during the Cattle Trail Survey by A. A. Abraham. Species of host plant unknown. The insects were enclosed by ants (Acromyrmex sp.) in small paper-like nests. Species described by Prof. Newstead in the Bulletin of Entomological Research, Vol. X., Part ii., January, 1920.

94. *Lecanium jaculator.* Laing.
Occasionally found on the leaves of Mucca-mucca (*Montrichardia aculeata*). An uncommon species. Collected on Coast Lands by G. E. Bodkin, 9.12.20.

METAL ROMANCE.

8 Times More Precious Than Gold.

An interesting history attaches to a small packet about 2½inches square, which arrived in London a few weeks ago. It weighed 2½lbs., and was eagerly bought by an American firm for £1,200. The packet contained osmiridium, (osmium and its alloy iridium) used for the tipping of fountain pen points and for delicate bearings of fine machinery.

The discovery of osmiridium, which is a member of the platinum group of metals, constitutes an interesting piece of modern romance. Towards the end of last year a small group of prospectors were washing for gold in one of the river beds in Papua, British New Guinea. In their eagerness to find the precious metal they threw away from their pans a bluish-grey flaky substance as worthless. This was osmiridium, but the men did know it, and it is eight times more valuable than gold, and worth at the present time about £40 an ounce.

When the men got back to the settlement they mentioned the occurrence to a mining engineer, who immediately asked them what they did with the substance. They replied that they left it on the river bank, and the engineer exclaimed, "It must be osmiridium."

The next morning the whole party started for the spot, only to find on their arrival that the tropical rains and the swollen river had washed away most of the precious stuff. What remained was carefully raked together, refined and despatched to London, where it arrived safely a short while ago, having been heavily insured for the voyage.

Osmiridium is one of the hardest metals known and prospectors are eagerly searching for it in Papua.—*Daily Mail.*

AGRICULTURAL NOTES.

Watering Horses and Mules.

Opinions differ greatly as to the proper method of watering horses. Some claim that horses should be watered only before meals, and never when they are perspiring. The prevalent idea that if a horse be watered after a meal the water will force the food out of the stomach before it has been properly acted upon by the juices of the stomach, has practically no force.

But the stomach of a horse or mule is comparatively small; hence after a meal it is, or should be, practically full. The opening of the gullet into the upper portion of the stomach is somewhat constricted, and the opening at the lower part (called the pylorus) into the small intestine, is quite constricted. The contents of the stomach after a meal consist in small particles of solid matter mixed with the juice of the organ. It is a mechanical fact that fluids introduced into a receptacle containing particles of solid matter will not force the solids out of a small opening, but will percolate through the particles, and when the interstices become full, if the fluid does not escape, no more can enter. Hence, are we not justified in assuming that when a horse with a full stomach drinks water it percolates downwards and fills the intestines, then reaching the pylorus passes through it into the small intestine, and passing through that reaches the first division of the large intestine called the coecum, a sack-like organ of considerable capacity, where it is stored and taken up by absorption as required? If this theory be correct, it can readily be seen that a horse may be allowed to satisfy his thirst any time without forcing unprepared injecta out of the stomach.

Again, the idea that it is dangerous to allow a horse that is perspiring to drink water is too firmly impressed upon our minds. Of course, there are cases in which it would be dangerous to allow a horse free access to cold water, such as a case where the animal had been subjected to long continued and very strenuous labour, either fast or

slow, and had become excessively warm. The introduction into the system of large quantities of cold water might develop such severe reactions as to cause serious trouble. In such cases a few mouthfuls should be allowed, the horse well rubbed, and in a few minutes a little more water allowed. After the abnormal heat of the body has subsided he may safely be allowed to quench his thirst. Conditions of this kind seldom occur. The fact that in hot weather a horse doing ordinary work will perspire freely is no reason why he should not be allowed to drink as much water as he wants.

The horseman is justified in supposing that his horse's sensation of thirst is as acute as his own. This is frequently impressed upon his mind by the desire the horse exhibits in his haste to reach water when he is thirsty. When a driver is thirsty he usually finds means of allaying his sensation. When his horse is thirsty he "wants a drink" and, except under exceptional circumstances, his desire should be gratified as soon as possible.

Some horses are particularly predisposed to colic and will suffer if given food or water under certain conditions. Such animals should be treated accordingly.

(From the Bulletin of the Ontario Dept. of Agriculture, July, 1918.)

The Broody Hen.

Eggs intended for incubation should not be kept longer than ten days. It should be remembered that the fresher the eggs the stronger the germ. This applies to all eggs. If the eggs are to be hatched by a broody hen, a certain amount of preparation is necessary. In the first place, never sit a hen in a box with a wooden floor. This is apt to make the eggs too dry, and, owing to the hen scratching away the nesting material, the eggs are liable to get cracked by coming in contact with the bottom boards. Undoubtedly, the best method is to dig a hole about 2 feet in depth and 3 feet in diameter, pour in 2 or 3 gallons of

water, and then replace the earth. Make a slight depression in this earth just deep enough to prevent the eggs from rolling out, and line the nest with soft, clean hay or trash. The heat from the hen's body during the incubation period will draw the moisture up to the eggs through the bottom of the nest, and keep them sufficiently damp. Should the weather be very dry and windy, however, the eggs should be sprinkled with warm water during the last week until they begin to chip.

A box with a wire front may be placed over the hen. The front should be movable, so that it will not be necessary to shift the box each time the hen is fed and watered.

The best food for a broody hen is small, whole grain, such as yellow mealies, or Indian corn or barley. Never give soft food to a sitting hen, or a fouled nest will be the result. Grit and fresh water should be given daily, but withhold green food, as it is apt to loosen the bowels. If the weather is very dry, the ground in front of the broody box may be sprinkled with water and the hen allowed to dust herself in the moist earth. When setting a hen, especially if she is young and wild, give her a few nest eggs for the first three or four days, until she settles down. Many a good setting of eggs is saved if this precaution is taken. Do not give too many eggs; for the average size hen, thirteen is quite enough. Examine the hen carefully for insect pests, and, if found, dust a handful of flowers of sulphur well into her feathers, especially round the roots of the tail. (*Journal of the Department of Agriculture, Union of South Africa, September, 1921.*)

A Case of Indigestion.

A correspondent in the *Veterinary Record* gives the following account of an interesting case of indigestion in a cat.

'The cat in question was a neuter animal, white, age nine months. It was brought in by its owner one evening, who feared it was poisoned. The cat had been

vomiting on and off all day, and had been given a dose of ol. ricini, which had not acted.

'On manipulation of the abdomen I found the rectum and large bowel heavily impacted, and accordingly gave a gentle enema. This at first produced little relief, but on repetition, the cat, after some effort, passed a lump of coco-nut toffee, about 1 inch by $\frac{3}{4}$ inch and a quantity of blue knitting wool.

'The usual gastric sedatives were prescribed, and the cat made the usual uneventful recovery. I mentioned the case to Professor Symes, who opined the non-digestion of the toffee was due to its heavy content, and the state of comparative dryness of the cat's digestive tract, possibly due to the wool, which prevent the fat-splitting enzymes acting on the fatty envelope surrounding the sugar molecules of the toffee.'

Improvement of Method of Planting Cassava.

The following statement, attributed to Mr. A. B. Carr, of Trinidad, in respect of planting whole stalks of cassava, has apparently aroused a good deal of popular interest. Quoting Mr. Carr, the *Journal of the Royal Society of Arts* says:—

Hitherto the way of planting the cassava was in short portions of the stalk, measuring from 6 to 9 inches long; but purely by an accident it has been found that when the whole length of stalk of a cassava plant is planted, the tubers ripen and are fit to eat in four and a half months, against the old method which involves at least eight months. The manner of planting is simply to insert the lower end of the stalk into the ground not more than 2 or 3 inches deep; and in order to secure the growing plant against the force of the wind, if in an exposed position, the plant should be tied to a stake. Planting is usually done in the month of May. In new lands as much as 12 to 15 tons of fresh tubers can be obtained, whereas in old, partially worn-out lands, unless a liberal supply of

manure is allowed, not more than 6 to 8 tons of tubers can be depended on.

Concerning the uses of cassava in Trinidad, Mr. Carr writes:—

1. It is eaten as a vegetable, boiled in plain water.

2. It is made into what is known as farine, which is a coarse form of meal.

3. After expressing the juice, the dry tuber is grated into a meal which upon being exposed to heat on a flat iron plate is made into bread.

4. The expressed juice is boiled down and certain condiments are added, thus producing cassareep, which is the foundation of many good sauces.

5. Starch is also made from the tuber, the method of manufacture consisting simply of allowing the expressed juice to settle, the heavy matter being precipitated and, when dried, forming the starch of commerce.

It is known that alcohol can be produced from the cassava, which also contains sugar. If the price of sugar remains abnormal for a lengthy period of time, it is likely that scientists will turn their attention to the sugar contents of this tuber.

The cassava sauce known as cassareep appears to have preservative as well as flavouring qualities, and is an indispensable ingredient in the well-known West Indian dish 'pepper pot,' which is especially popular in British Guiana, where cassareep is manufactured in commercial quantities.

In connexion with the industrial use of the cassava plant for the manufacture of alcohol, it may be mentioned that an Englishman was recently in Trinidad and British Guiana, investigating districts most suitable for cassava growing, and it is understood that in British Guiana about 10,000 acres of land were purchased for such purposes on behalf of distillery interests in Scotland. It is reported that large areas of cassava in Madagascar and in Brazil have also been purchased for the same interests.

—*Agricultural News*

Arrowing.

Different opinions are held here on the subject of the arrowing of cane on the sugar content of the cane. The following therefore, from the Queensland Agricultural Journal, should be instructive :—

"The condition which produces what, after all, is but the natural functioning of the cane plant—namely, arrowing, flowering, tasselling, or spearing, as it is variously termed—is not yet generally understood, but it is mostly attributed to climatic factors. On very poor soils, arrowing is frequently common, but this does not apply to the large percentage of arrowing which is taking place this year. In the hotter cane areas, such as Java, Cuba, Hawaii, and North Queensland, arrowing is more or less universal, and as a large production of sugar takes place in these countries, arrowing is accepted as the common thing, and little or no comment is made on the matter. In McKay and the Southern cane areas the arrows usually take a much longer time to mature, *i.e.*, to become "fluffy" and blow away with the wind, and this is a good point in one way, as it takes the cane longer to mature, but it is a great obstacle in trying to raise seed from the arrow. For many years, endeavours were made at the McKay Sugar Experiment Station to raise seed from cane, but the arrows took too long to ripen, and the arrows from the different varieties of cane did not all ripen at the one time, so that the cross-fertilisation could not take place. About Cairns, where the arrows mature quickly, seedling work has been carried out with great success.

Experiments carried out in Hawaii many years ago showed that arrowed cane did not lose its sugar content, provided it was crushed as rapidly as possible. It has been further argued that arrowed cane did not make good plants, but experiments carried out at the Sugar Experiment Station at Mackay, using arrowed and non-arrowed plants of the same variety and age, actually gave a slight yield in favour of the arrowed plants in both the plant and first ratoon crops. As more sugar is extracted in the Ingham-Mourilyan district (where arrowing is usual)

from a lower tonnage of cane than anywhere else in Queensland, except the Lower Burdekin, the arrowing conditions need not be greatly feared. If there should be any decrease in the average sugar content of the cane of this year it is far more likely to be due to the great amount of rain experienced so late in the season than to arrowing conditions.

Noel Deerr, in his work on "Cane Sugar," says:—

"Arrowing marks the end of the vegetative period of the growing cane. It has been thought that arrowing had an influence on the sugar content of the cane; definite experiments by Harrison and by Prinsen Geerligs have shown that this belief is unfounded. After the cane has arrowed, no further formation of sugar takes place, but an elaboration of that already formed obtains, with an increase in the cane-sugar content and in the purity; eventually, however, the cane dies down, and then a breaking down of the cane sugar occurs. The time to which cane can be left standing after arrowing is very variable, and is dependent on variety and climate. In the Hawaiian Islands, cane may remain as long as six months after arrowing, before deterioration sets in."

Poultry Notes.

The following are the cures recommended for some of the most common complaints which affect fowls:—

For Intestinal Worms.—1. Isolate infested birds and destroy or disinfect their droppings while being treated.

2. Put one or two drachms of copper sulphate in each gallon of drinking water for one week or

3. Powdered pomegranate root bark (for tape worms) followed by two or three tablespoonfuls of castor oil or

4. Oil of turpentine, one or two tablespoonfuls, followed in four to six hours with castor oil.

5. Powdered santonin in five to eight grain doses is especially good for round worms.

6. Chopped up pumpkin seeds for tape-worms.

Good Cures for Worms.—For Worms in Air Passages.—1. Turpentine introduced by stripped feather into the windpipe.

2. Steaming with creolin and turpentine in hot water.

3. Feeding garlic in the food.

For Diarrhœa.—1. Subnitrate of bismuth, one to four grains two to three times per day or

2 Pulverised cinchona bark one to two grains three times per day and

3. Quinine one-eight to one-half grain twice per day.

4. Dry food or cooked and slightly moist food.

For Constipation.—1. Epsom salts twenty to thirty grains in one tablespoonful of water or

2. Calomel one to two grains and

3 Soft food.

For Lice.—1. Lard or vaseline over head under wings, and round anus.

2. Dipping in 15 per cent. kerosene oil emulsion, or

3. Dipping in 2 to 5 per cent. creolin solution.

4. Pyrethrum powder dusted among the feathers.

5. Clean nests, yards, and houses.

Try these Disinfectants.—For Intestinal Disinfectant.—One half to two drachms of copper sulphate in one gallon of drinking water, or

For Chicken Mites.—1. Lard or vaseline on legs, feet and head applied once or twice per week. Wash off scales.

2. Sprayed on walls, roosts, floors, and nests once per week for what is commonly called chicken mites or chicken ticks.—*From the Smallholder.*—(Eng.)

PLANTS WORTH KNOWING.

By J. F. Waby.

Nyctanthes arbortristis, "Tree of sadness," from India. A large spreading woody shrub, very rare foliage in pairs, ovate, entire, acuminate, 3-3½ inches long 2 inches wide, shortly petioled, dark green above, grey green beneath, of rough texture, main veins plain, wide apart, each pair of leaves set 2-2½ inches apart. Branches tetragonal, grey, brittle. Inflorescence a terminal leafy panicle. A green, gamosepalous, persistent calyx ¼ inch long, usually three or more together in a group. Flower tube $\frac{7}{16}$ inch long ⅛ inch diameter, red; segments white, 5-7½ inch long radiating from orifice of tube, of various widths up to ¼ inch, volute; flowers opening at dusk and falling early, fragrant. Fruit cordate, emarginate, flat, ⅝ inch long and wide, ⅛ inch thick, green, ripening brown, dehiscing in 2 valves, 2 seeded.

Solanum Westlandii, from Costa Rica. A tall growing glabrous climber with a few scattered short—hooked prickles on stems, branches and petioles. Foliage variable, bright green, soft as much as 10 inches long in some instances including the petiole 3 inches, 5 inches wide at the widest parts; uppermost simple, oblong, acuminate, others 3 lobed or trifoliate, with equal or unequal leaflets, terminals much larger than the others. All margins entire. Lower leaves 6-10 inches long, pinnate or primatifid with 4-6 pairs of lobes or leaflets. Inflorescence a spreading scorpioid cynre 6 inches or more across, opposite a leaf. A small green calyx of 5 sepals spreading ½ inch. The corolla, pale lilac blue, of fine crêpe texture, 2 inches diameter, salver shaped with 5 shallow lobes; a 5 rayed star running from centre to points of a paler blue than the corolla; a column of 5 stamens in the centre, ½ inch long, greyish, with very short filaments and broad anthers tipped with parple. Fruit said to be globose though none were apparent.

Wormia Burbidgei, from Borneo. A strong growing woody shrub with long straightish stems and small thick branches, general colouring dark brown, almost black. Foliage large, set close together, alternate, clasping the stem, obovate, 9 inches or more long, 6-7 inches wide at widest part, narrowing to the clasping base into a vagina 2 inches long $\frac{3}{4}$ inch deep texture tense, midrib pronounced, veins quite plain and regular, alternate, edges waved between the ends of the veins. Colour dark green above, yellowish green beneath. Inflorescence axillary opposite a leaf, racemose, 10 inches or less—5 of which is the general stalk, quite stout. Flowers set an inch apart, peduncle $\frac{1}{2}$ to $\frac{3}{4}$ inch long stout, opening one at a time. Calyx green of 5 cupped sepals, $1\frac{1}{2}$ inches across; corolla of 5 golden yellow petals, 3 inches across, each petal of waved crêpe texture, $\frac{1}{2}$ inch wide at junction of centre and an inch wide at end. A column of white filiform stamens occupy the centre $\frac{3}{4}$ inch high and $\frac{5}{8}$ inch wide, covering 6 fleshy green pyramidal carpels $\frac{1}{2}$ inch high, each with a filiform white pistil $\frac{5}{8}$ inch on top. The corolla falls early, after which the cupped calyx forms the outside of the fruit, forming greenish imbricated balls tinged with red on the edges of the individual sepals. Fruit a follicular capsule dehiscing whilst quite fresh, in several compartments, like the points of a compass, spreading 2 inches, dark red, with a whitish centre dividing the follicles, small red seeds attached to the sides.

Mussaenda macrophylla, Region Himalaya, Malaya. This genus is rather peculiar in that its particular beauty is not in its flowers but in its floral appendages, having various sized bracts which make the various species conspicuous. This species is a fair sized woody shrub. Foliage dark green, in pairs set 1-$1\frac{1}{2}$ inches apart, individual leaves 5-6 inches long, $1\frac{1}{2}$-2 inches wide, acuminate, entire, slightly waved. Midrib plain, whitish, prominent beneath, regular cross veins $\frac{1}{4}$ inch apart. Branches brown, speckled, woody. Inflorescence small terminal dichotomous cymes spreading 4 inches; flower tube an inch long, pale green linear; corolla red $\frac{1}{2}$ inch

across, cut into 5 segments with a yellow corona of massed stamens in centre; tube fitting into a green calyx with 5 filiform sepals $\frac{5}{8}$ inch long. Fruit a small capsule. In this species the bracts are cream coloured attached to the calyx, petiole 1 inch long channelled $\frac{1}{8}$ inch wide, blade 3 inches long and 3 inches wide, entire rounded or apiculuar, almost smooth front, beneath mid and other veins prominent, all emanating from the petiole with cross veins between.

Mussaenda luteola from Arabia and Nubia. A straightish several stemmed shrub with many twiggy small dark brown branches. Foliage in pairs set 1 inch to $1\frac{1}{2}$ inches apart, ordinary green, each leaf $2\frac{1}{2}$ inches long, 1 inch wide—though of various sizes less acuminate, almost sessile, midrib and veins plain, the latter $\frac{1}{8}$ inch apart. Inflorescence terminal in small cymes peduncle green filiform $\frac{1}{2}$-$\frac{3}{4}$ inch long. Individual flowers yellow, tubular, filiform 1 inch long, corolla $\frac{5}{8}$ inch across, cut into 5 acute segments, centre a deeper yellow, with a corona of tiny stamens; tube fitting into a tiny calyx with 5 filiform green sepals $\frac{1}{8}$ inch long. The bracts are sulphur coloured, making the inflorescence very conspicuous: they are foliaceous, peduncle linear $\frac{1}{2}$-$\frac{3}{4}$ inch long, blade ovate, entire, $1\frac{1}{4}$ inches long $\frac{7}{8}$ inch wide, to $1\frac{1}{2}$ inches long, $1\frac{1}{4}$ inches wide, acuminate, mid vein and the two side veins nearer the centre than the sides fairly plain, from which cross veins run to the edges, the under side is of a paler yellow than the surface, and the veins more prominent.

Bauhuria Galpini, from the Transvaal. One of the "Chapeau Napoleon." A fair-sized shrub with brown twiggy branches, spreading quite 6 feet across. Foliage very small, cordate, folding on central rib $1\frac{1}{4}$ inches long, alternate 1-$1\frac{1}{2}$ inches apart; petiole $\frac{3}{4}$ inch 6 ribs, besides the central one which acts as a tinge all radiating from the apex of the petiole: whole leaf $1\frac{3}{4}$ inches wide, each half $1\frac{1}{2}$ inches deep. Inflorescence axillary small cymes, opposite a leaf. Flowers 2 inches across of 5 petals, crimson—much like Nasturtium, short spathulate $\frac{3}{4}$ inch across, stalk $\frac{3}{4}$ inch. Pistil 1 inch small, stigma, 3

crimson stamens $1\frac{1}{4}$ inches long, with green anthers $\frac{1}{8}$ inch long. Peduncle stout 1 inch long; calyx of 5 straw-coloured sepals $\frac{1}{8}$ inch wide, $\frac{3}{4}$ inch long. Fruit a dark brown bean 5 inches long, $\frac{7}{8}$-1 inch wide pointed; ventral suture straight $\frac{1}{4}$ inch thick dorsal suture curved $\frac{1}{16}$ inch thick, obtuse at stalk end, stalk $2\frac{1}{2}$ inches long. Seeds bright brown, oblong, thin $\frac{1}{2}$ inch by $\frac{3}{8}$ inch.

Banhuria purpurea another "Chapeau Napoleon." A small tree with stout rough-barked stem, strong loose branches. Foliage alternate, leaves $1\frac{1}{2}$—2 inches apart, petiole $1\frac{1}{4}$ inches long, blade $4\frac{1}{2}$—$5\frac{1}{2}$ inches wide—though many smaller—cordate with a deep cut V-shaped of $1\frac{1}{2}$ inches down to the central hinge like midrib by which the two halves may be folded over each other; entire, 5 main veins on each half with cross veins between, all main veins radiate from the apex of the petiole into a gland at its summit, the veins plain on the surface and prominent beneath, colour above ordinary green, paler beneath; texture tense. Inflorescence a terminal panicle of few flowers, about 4 inches or more long, floral stalks quite green. Individual flowers with slightly coloured brown peduncle an inch long, stout; corolla stretching 4-5 inches with 5 petals, the back pair in line, each of the pair 2 inches long, $\frac{5}{8}$ inch wide with $\frac{5}{8}$ inch stalk, quite purple; 2nd pair similar, centre petal petal $1\frac{1}{2}$ inches long $\frac{3}{4}$ inch wide, purple with whitish base $\frac{5}{8}$ inch long, stalk same as the others, all pointed, and fitting into a bed of 5 white bases of the sepals; a green calyx boat shaped, of green collected sepals, an inch long and $\frac{3}{4}$ inch wide, ribbed, tinged with pink between the ribs, 3 stout pink stamens like strong fish hooks, $1\frac{1}{4}$ inch long, the anthers forming the barbs, $\frac{5}{16}$ inch long, $\frac{1}{8}$ inch wide, green. Pistil $1\frac{1}{2}$ inches long, green, stout, shewing the form of the insipient bean (pod) with whitish end $\frac{1}{2}$ inch below the thick flattish stigma. Fruit a brown bean 9-10 inches long, $\frac{3}{4}$ inch wide, $\frac{1}{8}$ inch thick at ventral suture and less at the dintals one, dehiscing when dry: seeds brown, flat, or $\frac{1}{2}$ inch by $\frac{3}{8}$ inch.

There is a pendant variety of this species, the only difference in the two is the pendant branches; the colouring of the flowers, size, etc., are absolutely the same.

Ochrosia Moorei, of Australia. A small tree with regular branches spreading all round; branches contain a milky juice. Foliage in 3's set closely together, individual leaves obovate 3½ inches long, 1½ inches wide, dark green above, paler beneath, midrib plain, other veins fine and set close together across petiole ¾ inch long; texture fairly thick and tense. Inflorescence in terminal small cymes; individual flowers very small tubular white ¾ inch long, tube ½ inch narrow, 5 narrow petals spreading 1¼ inches, tube fitting in small green calyx. Fruit in pairs, end to end, fleshy follicle, scarlet, 2 inches long, 1¼ inches, ridged both sides. Flesh thick, white, one seeded, indehiscent.

THE CULTIVATION OF THE AVOCADO PEAR.

BY FITZ GREEVES, SENIOR AGRIC. INSTRUCTOR, DEPARTMENT OF SCIENCE AND AGRICULTURE.

From observations and the many questions that have been asked from time to time, one has to conclude that the correct method of planting this very valuable fruit in the Colony (particularly along the Coast lands) is yet doubtful.

The Avocado may properly be described a "Salad Fruit." Although technically it is a fruit, yet it is as much a salad as the Cucumber, and may be said to stand alone as the only fruit that, when ripe, is eaten almost exclusively as a salad.

In trying to eat it for the first time, one is often inclined to pronounce it as tasteless and insipid, therefore

to relish it, one has to acquire a taste for it, after which it is more or less pronounced a delicious fruit. It is the rule, however, that the taste for any new article of diet has to be cultivated, and a food which was unknown to our forefathers and which we meet for the first time after our tastes have been formed is seldom accepted at first trial.

Origin.

It is supposed to be a native of Tropical America, but writers differ as regards the exact place of origin. The Avocado was not cultivated in the West Indies before the time of Columbus. That such an important food plant was confined to the American Continent until this time, was probably due to the fact that the fruit will not easily survive long voyages.

Common Names.

The most common designation among English-speaking people is "Alligator pear," but this term is inappropriate and misleading; hence the name "Avocado" is more likely to avoid confusion of this fruit with other varieties. Other names by which it is called by different writers are :—Albecato pear, Avicato, Avigato, Avoca, Avogato pear, Butter pear, "Midshipman's butter" and Shell pear.

Propagation by Seed.

The Avocado tree is propagated almost entirely by seed, some of which come true. Like most tropical fruits, the seed of the Avocado, if dried will not retain its vitality for any length of time, and should be planted as soon as possible after it is removed from the pulp. If carefully packed so as to conserve moisture, the seeds can be kept alive long enough to permit of their being sent to any part of the world.

It is recommended that the seed be planted where it is to remain, as the long tap-root makes it difficult to transplant; but if transplanted when small, this will, however, be no great obstacle. In places where drainage is difficult, it is better to plant the seed first into a basket or any other receptacle from which the young plant may

be removed without injuring the lateral roots, and when planting, the tap-root should be drawn out and cut back to about two inches from the stem. When this root is allowed to remain, it continues to grow downwards, if there is no obstacle, and when it reaches the subsoil the tree eventually dies ; this invariably happens. A little before the tree begins to fruit or soon after a crop or two. It can also be propagated by budding or grafting.

Description.

The Avocado tree grows to a height of from 15 to 50 ft. In favourable situations the top is very dense. Different forms of leaves, all referring to the same species, vary so greatly in form and size, that close relationship would hardly be suspected. The character of the leaves varies at different stages of the trees' development.

The large broad-leaved forms are more generally found. The tree is usually green but in some localities the leaves are dropped just before flowering, leaving it naked for a short time.

When the fruit is fully matured the seed separates from the flesh. The best varieties for exportation are those having a small seed cavity which is entirely filled up by the seed so that it will not shake and injure the fruit in shipping. The pulp must also be, as nearly as possible, free from fibre. As with most fruits, the largest and fairest are not always the best flavoured. The delicate nutty flavour of some of the small kinds is seldom equalled in the large varieties.

Soil.

The Avocado is less exacting in regards to soil than it is with respect to climatic and other conditions. Drainage is the most important factor. Trees can be grown in almost any soil, but must always have good drainage. They seldom do well in perfectly open places where they are exposed to high winds, and where the bare ground around the roots is open to the scorching rays of the sun. Low flat situations are unsuitable to its cultivation.

To be successfully grown, the tree must be planted in protected situations if the locality is at all subjected to high

winds. In uncultivated places an occasional application of some fertilizer around the roots is necessary to keep the tree in a healthy condition.

Bearing Age.

In favourable localities Avocado trees will come into bearing between the fourth and fifth year from the seed. Budded or grafted trees should bear earlier. At first flowering very few fruits should be expected from a young tree, but the yield should increase until the tenth or twelfth year. Some writers give the life of the tree as 80 years. This is not a very high estimate, for very old trees are common in some parts of this Colony, as well as in other tropical countries.

Harvesting.

The time to pick the fruit depends almost entirely upon the time it has to be kept. When the fruit is required for local consumption it may be allowed to ripen more on the tree than when it is gathered for exportation.

The best time to pick the red varieties would be as soon as they begin to colour and the green ones when the colour begins to become lighter; there is no evidence to prove that remaining longer on the trees improves the quality of the fruit. Some of the green varieties, however, do not change colour appreciably on ripening.

The method of picking the fruit is of primary importance. In some places the fruit is knocked from the tree with long poles or the tree is climbed and the fruit shaken to the ground which of course ruins its keeping qualities and causes it to ripen unevenly. These methods are most unsatisfactory and detract considerably from the keeping qualities of the fruit.

It would seem that the best method of gathering Avocados is by using some pruning instrument with an open bag or basket attached to the end of a pole under the cutter, so that the fruit when cut would drop into the receptacle and not on the ground. Picking the fruits with the stem on is very desirable.

Packing and Shipping.

Taking into consideration the nature of the fruit, it seems that the Avocado, like most tropical fruits, keeps best when packed in such a manner as to protect it from bruises or undue pressure, and in such a way that the fruit can be well ventilated. Bruised fruits will rapidly decay and if in contact with others will also cause them to spoil. It is unnecessary to wrap the fruits in paper when they are separated from one another and are protected from bruises.

Fruits that are shipped must be kept in a cool place to ensure their keeping.

Considering all the data available, it seems fair to conclude that the Avocado has a fairly high percentage of food-value as compared with other succulent fruits.

HOW BEST TO UTILIZE THE RESULTS OF AGRICULTURAL RESEARCH IN PRACTICAL FARMING.

By Dr. J. Augustus Voelcker.

We reproduce herewith some extracts from this paper which was read at a meeting of the Farmers' Club in London during October of last year.—Editor.

It appears to me desirable to consider the question under the following heads :—

1. The sources of our information.
2. The agencies which exist for the dissemination of that knowledge.
3. The methods to be adopted in bringing such knowledge to bear upon practice.

1. *The sources of information.*—These are primarily centred in Universities, in Colleges, and in Experimental Stations, both at home and abroad. It is here that work of inquiry and research, often of a purely scientific character, is carried out, and to them every encouragement should be given. It is such institutions that make it their business to collect and to study what has been done elsewhere, to develop it, to open up new fields of inquiry, and, finally, to turn the results to a practical end.

Until of late years little has been done in this direction for agriculture at our universities, but these centres are now alive to the necessity of making a forward step, while in our world-renowned Rothamsted Experimental Station we have the best example anywhere of an institution devoted to the pursuit of inquiry into the problems of agricultural science, and to the making of the results beneficial to practice.

Somewhat similar stations exist throughout the United States of America, in Canada, India, and on the Continent generally.

These are, and must continue to be, the main sources of information, and their work primarily is to collect and examine all such information.

2. *The Agencies for the Dissemination of Knowledge.*—In addition to Universities and Experimental Stations as mentioned above, there are our Agricultural Colleges and Institutes, many of them with experimental farms and demonstration farms attached to them. Next we have, in many of our counties, Agricultural Organizers and itinerant lecturers, and, above all, the Ministry of Agriculture itself, regulating and encouraging the work by grants in aid. Lastly come the Agricultural Press and the various books and publications on agricultural subjects.

The work of each of these may best be discussed under the third heading, which is the main purport I have in view.

3. *Methods to be Adopted in Bringing the Teachings of Science to the Farmer.*—In considering these it seems to me that, at the outset, one has to draw a line between

the older generation and the younger. Here and there may be found an individual of the older generation who has more or less closely followed the work done at Rothamsted and elsewhere, who is appreciative of the results there obtained, and is ready and eager to avail himself of the teachings ot science ; but this cannot be said of the generality of present-day farmers, who still are only too ready to maintain that an ounce of practice is worth a pound of science. But even they are not slow to use some new material which science has evolved, or which has proved to be beneficial. Still, for the far greater part, it is to the younger generation of farmers—those who have been through our colleges and institutions—that one has to look for a better appreciation of science and of what it has done.

It is they who, by their early grounding in the elements of science, are in a better position to understand and to put into practice the teachings of science, and it is in them that the hope of the future lies.

(a) *Reading* is, of course, one of the methods that suggests itself for our purpose But the ordinary agriculturist is not a great reader. He may look over his agricultural newspapers, but it is rarely for the purpose of learning. He may follow, by it, the course of the markets, the winners at shows, the prizes obtained at sales, and so on. But he will not, as a rule, really study or read such a thing as a text-book, or follow closely the details of an experiment.

For this the lack of an early training in the elementary principles of science is largely responsible, but this is now in a fair way to be remedied through the increased attention given to the claims of science as part of a sound education.

Present-day farmers, however, are workers, not readers, and it has been truly remarked that it is far easier to get an agricultural book in the Strand than in any country town.

Text-books are regarded as things for students, and journals and reports of agricultural societies are more generally allowed to accumulate than be read.

The leaflets issued by the Ministry of Agriculture have, however—mainly by their brevity—accomplished a good deal, more especially when dealing with subjects of current importance. Still, agricultural newspapers remain the main source of reading to the ordinary farmer, and the marked improvement that has characterised them of late years shows that a powerful agency exists in the agricultural Press for disseminating knowledge. It is to the credit of our agricultural newspapers that many of them have evinced a desire to give greater prominence to the bearings of science upon agricultural practice, and to do something towards popularising the work of Rothamsted and other experimental centres.

But, though the above may be the case as regards the present generation of farmers, I look to something very different in the future, and while standard books such as Johnston and Cameron's "Agricultural Chemistry and Geology" and Warington's "Chemistry of the Farm" will long retain their position, later works, such as those by A. D. Hall [(1) Soils, (2) Fertilisers and Manures, (3) Feeding of Crops and Stock], and the still later ones by E. J. Russell and other contributors to the Agricultural Monographs issued by the Cambridge University Press, will become the heritage of the agriculturist of the future.

In the "Book of the Rothamsted Experiments," the results of many years of laborious research carried out at Rothamsted have been brought together, first by Hall and then by Russell. The book forms a good and useful summary of the work done at this station.

These, though they may be more or less "sealed books" to the present farming class, will be almost indispensable to the farmer of the future.

(b) *Experimental Stations.* These, whether at home or abroad, contain the real pioneers in agricultural science. At them are the workers, often engaged on purely scientific inquiries, but working each in his own sphere, and to a common end.

What is really required is to bring all such work together and to turn it into an agricultural and practical

direction. This should be the aim of the Director of every such station.

The need of this is coming to be more and more recognised, and in our own leading station of Rothamsted the endeavour is being made, more than ever before, to show how science may come to the help of the farmer.

It is the part of such stations not only to carry out investigations of their own, but also to follow the work done elsewhere, to examine it, to put it to the test, and to develop it further.

A visit to Rothamsted—where the study of questions regarding the soil is the main object—will bring home to one how many are the different branches of science which contribute their quota to the elucidation of problems in agriculture—chemistry, physics, botany, biology, and bacteriology all having a prominent share.

The same is true of plant-breeding and of animal husbandry and nutrition, which are pursued mainly at Cambridge University, and, again, of forestry, as at Oxford University. At the latter the separate but important branch of Agricultural Economics is taken up specially.

Similarly, at the Imperial College of Science, the John Inns Horticultural Institution, the National Institute of Agricultural Botany, and other institutions, there are highly trained scientific workers who are pursuing their researches and carrying on work which cannot fail in the end to influence largely the progress of agriculture.

It is really such establishments as these which can alone originate any movement, and to which recourse must be had for the enlargement of our knowledge, and it is to them, therefore, that the greatest support, moral and financial, should be given. From them must filter down, through the teachers of our agricultural colleges and similar institutions, a knowledge of the results attained and the fresh truths learned, and in this way become a part of our agricultural "stock in trade."

The reports themselves issued from such experimental stations may be too scientific and too technical for the

ordinary reader, but, rightly interpreted by the competent teacher, they may be duly understood by the student and incorporated in his practice later.

It is on such grounds that I advocate strongly the support of experimental stations of the highest class, as the real storehouses and working-hives of agricultural science.

One caution must be given, and that is that these stations do not, by becoming too purely scientific in their work, lose sight of the practical end. There is some danger of this occurring, and it is, accordingly, a satisfaction to record that, under Dr. Russell's guidance, Rothamsted is interesting itself not merely in strictly scientific inquiries but also in such practical matters as the mechanical working of the soil, the use of new manurial substances, the treatment of sewage, the conservation of farmyard manure, the sterilization of the soil, the electrification of crops, etc.

A great deal can be learned by a visit to such a station though it is the worker or teacher in agricultural science who is best able to profit by this.

Besides Rothamsted, we have, on a much smaller scale, but on similar lines and on a very different soil, the experimental station at Woburn. As, however, this has lately been given up by the Royal Agricultural Society of England, though it will be continued by myself, I had better at present say no more about it.

On the Continent, and through the United States and Canada, as also at centres in India and elsewhere, there are experimental and research stations, each issuing regularly its report of work, and, in turn, keeping in touch with Rothamsted and other stations.

The work of these is regularly summarised in the "International Review of the Science and Practice of Agriculture."

CONCLUSIONS.

It will be seen from the foregoing that I consider the best means of utilising the results of agricultural research in practical farming is the introduction of a better system of agricultural education, with a greater appreciation of the part that science can play in this.

The truth is that there has been, in the past, too much misunderstanding between the practical man and the scientist. The practical man mistrusts the scientist as being purely theoretical, and the scientific man looks on the practical farmer as conservative and unreceptive. This has been the great bar to real progress to be attained by a combination of the two.

What is required now is that the two be brought closer together and made to understand one another better.

There will always be need for the purely scientific worker in our experimental stations and Research Institutes, but it is the duty of the Director to see that the researches are turned to a practical end.

Then, through the teachers at our Colleges and Agricultural Institutions, the lessons of science must be interpreted and their practical bearing be set out clearly, so that they may be grasped by the farming student.

For this to be successful, it is clear that the teachers while well versed in science, must also be practical men themselves, so that they may possess the confidence and respect of the student and the farmer.

In this way alone can a better understanding be brought about, and a true co-operation exist between science and practice which shall work to mutual advantage and the ultimate benefit of agriculture.

Further, let it be remembered that farming is a business, and it is the aim of the farmer to make his a commercial success. A scientific discovery may of itself be highly interesting, but it will be useless to the farmer unless it can be shown him how to turn it to a commercial success.

I consider, accordingly, the best means of utilising the results of agricultural research in practical farming to be an improved system of agricultural education, and this through the introduction of elementary science into an ordinary educational curriculum.

In the varied ways that I have indicated I believe that an acquaintance with the teachings of science can be

brought down from experimental stations such as Rothamsted, and from research institutions such as exist at our universities, etc., and through the agency of principals and teachers at Colleges, lecturers in counties, etc., be passed down to the pupils themselves and, ultimately, to the workers on the land.

That the work is anything like perfect is far from being the case, but that immense progress has been made of late years is undoubtedly true, and, as time goes on and methods improve, I am confident that, though the present generation may not themselves benefit greatly, the future one will be brought up with a better appreciation of the lessons of science, and a greater readiness to apply its teachings to their own farming practice.

BOTANICAL, PLANT DISEASES AND PEST NOTES.

How to Free a Community From Mosquitoes.

Before a successful mosquito campaign can be conducted, public interest must be aroused and co-operation secured. While the work done by inspectors accomplishes a great deal of good, much more can be accomplished when the public is sufficiently interested to co-operate in eradicating the mosquito. When public sympathy is lacking, the inspectors cannot make the progress that is desirable. A vast amount of good can be done by cleaning up the various dumps where are deposited tin cans, old bottles, coconut husks, and other containers which hold water, by screening all cisterns and water barrels; by oiling every pool of standing water; and by draining water from and filling in the low places. This is, however, just the beginning. The real work commences with the weekly inspection, because by this time the public is likely

to have lost some of its interest, and is ready to relax and weaken in its good resolutions. This is, then, the critical time, and unless the inspectors are constantly on the watch for new mosquito breeding places it will be only a short time until conditions are as they were before the work was undertaken. After the general clean-up, ceaseless and untiring efforts are necessary to prevent a return to old conditions, but the small work required is worth while when it results in ridding the Tropics of its most serious pest.—*Circular 20, Porto Rico Agricultural Experiment Station.*

Insect Pests.

There are always bomb shells being thrown about. A scare was created some time ago by a statement from California, that all present efforts in the control of insect pests would be set at naught soon because owing to the quick generations of such minute insects, they would soon evolve strains proof against sprays and proof against their natural enemies.

There is possibly something in this, but it is mostly humbug. Even though generations of such low forms of animal life are quick, it is quite as clear that the enemies are on an equal plane and their tastes and appetites would follow suit; they would not starve. And surely the brain and skill of man can evolve, invent and prepare new concoctions equal to deal with insects.

The war taught us how quickly the brain of man could invent means, machines, and instruments of destruction, to destroy mankind. Then what about an insect!

Here is the "fool-fool" paragraph:—

"Something of a sensation has been produced among Californian fruit growers by the suggestion of the Principal of Entomology of the Washington State College that possibly under continued spraying with insecticides

hardier strains of insect pests are being produced, which are better and better able to withstand the effects of the poisons.

"In other words," said Professor Melander in his address, "it is possible from a biological standpoint that we are breeding the resistant insects. If there is such a thing as this, it is a big, big thing in the fruit world. A few years ago we were cocksure that sulphur-lime would kill red spider eggs, would kill eggs of the green aphis, and yet I have examined I don't know how many millions of red spider eggs this year and failed to find them dead after being sprayed with sulphur-lime. The same can be said of the green aphis in a good many localities. Whether it is a biological fact that scale and other insects are becoming resistant by a gradual process of weeding out the individuals that are not hardy I do not know; but I do know that some of the standard sprays are not nearly so sure and effective as they used to be. That is the main thing that I wanted to surprise you with at this time. If the biological theory is true, that we are breeding up scales that are resistant to this or that spray, it may be that we shall have to switch our methods of fighting the pests, we will say, every twenty years. We will spray with sulphur-lime; that will be best for twenty years, and then we will switch over and take up the oil emulsion and spray with that for twenty years until we get a scale that is resistant to oil emulsion, and then come back and switch to the other. Biologically it is possible to rear up a breed that would be resistant." *Journal of the Jamaica Agricultural Society.*

Forcing Mangoes.

In the great mango district in Cavite, near Manila, especially, mango trees are annually forced into fruiting for the Manila market.

The firing is sometimes started as early as August, but is also done as late as December. It is sometimes

done merely by burning brush on the ground beneath the mango trees, but where it is more "professionally" done, so to speak, a cone-shaped enclosure with a tall chimney ending in the top of the tree is built of green wooden stakes and a thin-walled bamboo, woven together. The lower part of the enclosure is plastered with a mixture of mud and straw on the outside and the "oven" is ready for operation. Green brush and weeds are used for fuel with the idea of producing a thick smoke. The wiry growth found at the base of the spiny bamboo, *Bambusa spinosa* Roxb., is considered especially good fuel. Sometimes a small quantity of sulphur is put in the fire. At no time is the fire made so hot that the trees are injured.

After the firing of a tree has begun, the tree is "smoked" heavily and continuously day and night for a week. Thereafter light fires are made morning and evening for about a month, or until the trees come into bloom. As a rule the fires are then put out, but a light "smoking" is sometimes given the trees to drive away the mango hoppers, which are recognized to be destructive to the bloom.

Trees forced early in the season sometimes come into bloom before the rains are over and, failing to set because of excessive moisture, they are then subjected to a second firing.

It is claimed that mango trees can be forced to fruit any time of the year by the means of the method described, provided, of course, there is bright weather during the flowering, for rain invariably destroys the flowers.

Composition and Uses of the Mango.

The following analyses of the Carabao, Pico and Pahutan mango are quoted from the Philippine Journal of Science:

TABLE II.—*Analysis of Philippine Mangos.*

Variety.	Fruit average weight	Edible Portion	Skin	Seed	Total solids	Insoluble solids	Protein	Ash	Sugar as invert
	grams	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*
Carabao (ripe) ...	240	73	11	14	17.2	2.6	0.22	0.45	13.24
Carabao (green)..	175	70	20	10	13.7	2.8	0.28	0.25	1.90
Pico (ripe) ...	230	73	12	15	23.6	2.8	0.75	0.40	18.40
Pahutan (ripe) ...	85	60	18	22	25.7	8.1	1.12	0.53	17.54

Except in the weight of the fruit and in the percentage of the edible portion, which vary to a considerable extent in the different races and varieties, the above analyses are fairly representative of the mangos grown in other parts of the world.

The mango in the Tropics takes the place of the apple in the Temperate Zone, but as an article of diet it is more valuable than the apple because its large sugar content has considerable food value.

The favour with which the mango is regarded in the Tropics may be taken as an indication of its coming popularity in the Temperate Zones when the better class of mangos are once introduced there.

In some parts of Spanish America where the seed is large and the flesh is fibrous, the mango is eaten with the aid of a three-pronged fork having one long central tine that penetrates the seed, and two shorter ones that prevent the seed from turning. The fruit of the fiberless varieties may be served in halves, or the skin may be cut transversely near the tip and also near the base. By making a longitudinal cut connecting the others, the skin is then easily peeled off. This leaves the flesh exposed and yet allows the fruit to be held in the hand without soiling the fingers.

Excellent mango sauce, very similar in flavour to that made from the apple, may be made from the full-grown, immature mango. It is prepared by peeling the fruit, slicing the flesh, and boiling it together with a little water, adding sugar to taste.

The sauce strained through a thick cheese-cloth, and the juice diluted with water and sweetened makes an excellent mangoade. Excellent ice cream may be made from the mature mangos or the sauce from the immature mangos already referred to.

The following recipes for utilizing the fruit will also be found useful:

Jelly.—Peel the mango as it begins to turn yellow, before it softens; slice the pulp from the seed; pour enough water in the pan to cover the fruit, and boil until quite tender; strain through muslin cloth; to this juice add an equal quantity of sugar and boil till it jellies Lime juice may be added if more acidity is desired, *i.e.*, in the jelly than is present in the mango.

Marmalade.—The pulp left after the juice has drained off in making jelly can be run through a fine sieve, boiled with an equal quantity of sugar and a little lime juice added to make it firm, until it thickens like cheese. (Marmalade, of course, can also be made direct from the fruit, i.e., with its own juice retained.)

It has been stated that if the mango seed is boiled together with the preserve, this will retain the flavour of the fresh mango. The seed, of course, is thrown out when the preserve is put up in jars.

Mango preserves.—Select mangos just showing colour; peel and slice; to each kilogram of fruit use 1 kilogram of best white sugar and 2 teacups of water; boil the sugar and water until it drops from the spoon very heavily, then pour over the fruit and let stand until cold. Pour off the sirup and boil down as before; when the sirup is quite thick, drop in the fruit and boil hard for twenty minutes. Seal at once.

Candied mangos.—Select mangos just showing color; peel and cut from the seed in large pieces; use 1 kilogram of sugar and 2 teacups of water for every kilogram of fruit; boil the sirup and pour over the fruit, letting it stand two or three hours; then put on the fire and bring all to a boil; let stand over night; next morning pour

off sirup and cook till it threads; pour over fruit again and let stand till next day. Repeat this process every day for three days, by which time the fruit will have absorbed all the sugar it can take. On the fourth day drain off the sirup and cook till it threads, drop in the fruit and boil about five minutes, very hard; drain off all the sirup, using a porcelain colander; when the fruit is dry lay on plates in a hot, airy place, in the shade, until it is well dried and cover it with a thin cloth.

Chutney.—Take 3 kilograms of pulp of the common mango (turned but not ripe), 3 kilograms tamarinds, 2 kilograms raisins (weighed after stoning), 8 kilograms brown sugar, 0.5 kilogram chilies, 2 kilograms green ginger, 0.5 kilogram garlic, or 1.5 kilograms onions, 0.25 kilogram mace, 65 grams mustard seed, 15 grams cloves, 15 grams pimento, 0.5 kilograms table salt. Soak the tamarinds in 4 liters of the best vinegar, stir them about with a wooden spoon to get the pulp off, and take out the seeds. Cut the raisins small. Peel the ginger and grate it. Pound the chilies, garlic and mustard seed in a mortar, using a little of the vinegar for moistening. Mix all together thoroughly with the mango pulp. It is then ready for use.

The mango is used as a pickle to some extent in the Philippines and it is similarly prepared in India. In that country, where the mango is an important staple of food, the fruit, immature and ripe, is utilized in many ways.

When green the stone is extracted, the fruit cut into halves or slices, and (*a*) put into curries; (*b*) made into a pickle, with salt, mustard oil, chilies, and other ingredients; (*c*) made into preserves and jellies by being boiled and cooked in sirup; (*d*) boiled, strained, and with milk and sugar made into a custard known as "mango fool;" (*e*) dried and made into the native "ambchur," used for adding acidity to certain curries; (*f*) when very young cut into small pieces, mixed with a little salt, and sliced chilies and milk added, it forms a "tasty salad."

When ripe (*a*) it is made into curry which has a subacid, not unpleasant taste; (*b*) it is cut into small

pieces and made into a salad with vinegar and chilies (the sour fruit is sometimes so used); (*c*) the juice is squeezed out, poured into plates, and allowed to dry; this forms the thin cakes known as "amb-sath." The kernels are eaten in times of famine, and by the poorer classes in many parts of India they are boiled and eaten as greens. They are also ground with meal and mixed with various other ingredients to form a relish known as "am-katai." When stuffed with coriander, turmeric, and other spices and boiled in mustard oil, they are esteemed a great delicacy.

—*Bulletin No. 18. Bureau of Agriculture. Philippine Islands.*

RESUME OF MEETINGS OF THE BRITISH GUIANA SUGAR PLANTERS' EXPERIMENT STATIONS COMMITTEE HELD IN DECEMBER, 1921, AND FEBRUARY, 1922.

A meeting of the B. G. Sugar Planters Experiment Stations Committee was held on Monday, the 12th December, 1921, when the following members were present: Sir John Harrison, C. M. G., Chairman, and Messrs W. M. B. Shields, A. E. Bratt and H. Deverill.

The Secretary was instructed to notify the B. G. Sugar Planters' Association that the three senior members of the Committee for 1921, the Hon R. E. Brassington and Messrs. A. E. Craig and A. E. Bratt

would retire on the 31st December but were eligible for re-election by the Association.

An application having been made by Messrs. Sandbach Parker & Co. for the purchase of 30,000 cane tops for export, Mr. Shields proposed, seconded by Mr. Bratt, that no cane tops be sold by the Committee for exportation from the Colony. This was passed unanimously.

In connection with the raising of new seedlings, the Chairman advised the Committee that it would be more profitable if original and older varieties such as Red Ribbon, White Transparent, D 625, etc., be selected as parents rather than to use seedlings of later generations.

The Superintendent notified the Committee that tops were ready for distribution. He was instructed to write to the town agents asking them to make arrangements for the delivery of such tops as they might select, to their respective estates.

The January meeting having fallen through for want of a quorum, the Committee did not meet again until 13th February, 1922. On this date the following members attended. Messrs. W. Francis, F.I.C., Chairman, A. E. Craig, W. M. B. Shields, H. Deverill, Hon R. E. Brassington, Mr. G. E. Anderson, who had been appointed by the Planters Association in place of Mr. A. E. Bratt, resigned, and Mr. Jas. Smith, who had been appointed *locum tenens* for Mr. R. Strang who had left the Colony.

There was much discussion in regard to the working of the Experiment Stations, the feeling of the Committee being that the time had arrived when a proper and systematic survey of the soils on the various Sugar Plantations should be made and asked the Chairman to recommend to the Government that the Analytical Staff of the Department be increased in order to cope with the extra work which would be required to be performed in consequence of the survey.

ATTENDANCES AT THE DISTRICT GARDENS.

Year.	Bourda.	Belfield, E. Coast.	Stanleytown, New Amsterdam.	Suddie, Essequibo.	Den Amstel.	Houston, E. Bank.	Wakenaam.	Total Attendances.
1912 ...	5,514	4,395	3,302	2,100	2,544	2,156	718	21,729
1913 ...	5,156	4,535	2,519	3,399	2,568	1,836	1,319	21,332
1914 ...	4,243	3,869	2,443	3,025	1,791	1,653	1,533	18,577
1915 ...	1,123	1,006	769	59	503	339	401	4,200
1916 ...	4,705	1,161	1,510	225	623	2,251	1,297	12,026
1917 ...	4,991	2,820	1,366	3,297	1,186	2,564	1,663	17,086
1918 ...	4,834	3,081	1,653	2,671	2,162	2,790	2,067	19,258
1919 ...	4,769	2,425	1,582	2,798	1,851	2,480	1,556	17,461
1920 ...	6,285	2,312	1,665	2,525	2,532	3,228	2,148	20,695
1921 ...	5,671	1,968	1,682	2,629	1,949	2,539	1,610	18,048
1922 ...								
1st Quarter	1,010	532	435	637	510	490	350	3,964

Meteorological Data—January to March, 1922.

1922 Months	Rain-fall.	NUMBER OF DAYS OF RAIN						Evapo-ration.	Air Temperature and Humidity.			
									Air Temp.			
	Total Inches.	Under ·10 Inches.	·10 to ·50 Inch	·50 to 1.00 Inch	1.00 to 2.00 Inches	Above 2.00 Inches	Total days.	Inches	Maximum.	Minimum.	Mean	Humidity. Mean.
Botanic Gardens.												
Jan. ...	6.37	14	9	1	1	...	25	4.01	83.5	75.4	79.4	79.7
Feb. ...	3.60	7	12	...	...	...	19	4.58	83.9	75.3	79.6	77.4
March ...	1.88	9	5	...	...	...	14	5.54	84.0	75.6	79.8	76.4
Totals & Means.	11.85	30	26	1	1	...	58	14.13	83.8	75.4	79.6	77.8
Berbice Gardens.												
Jan. ...	4.38	9	5	4	...	...	18	...	83.9	74.4	79.1	82.6
Feb. ...	3.99	6	3	...	...	1	10	...	85.8	74.5	80.1	78.3
March ...	.85	5	4	...	...	...	9	...	85.9	74.7	80.3	75.3
Totals & Means.	9.22	20	12	4	...	1	37	...	85.2	74.5	79 8	78.8
Onder-neeming.												
Jan. ...	10.18	5	4	3	1	2	15	...	Not available			
Feb. ...	3.03	1	3	1	1	...	6	...	Instruments out			
March ...	2.91	...	7	...	1	...	8	...	of order			
Totals	16.12	6	14	4	3	2	29	...				
Mora-whanna												
Jan. ...	10.31	1	4	9	2	...	16	...	...	...	...	...
Feb. ...	6.70	2	5	4	...	1	12	...	...	...	...	...
March ...	7.55	...	7	2	1	1	11	...	...	...	...	...
Totals ...	24.56	3	16	15	3	2	39	...	...	...	...	...

EXPORTS OF AGRICULTURAL AND FOREST PRODUCTS.

Below will be found a list of the Agricultural and Forest Products of the Colony exported during the first quarter of 1922. The corresponding figures for the two years previous and the average for the four years previous to that are added for convenience of comparison.

Product.	*Average 1916-19.*	*1920.*	*1921.*	*1922.*
Sugar, tons ...	22,896	19,449	15,864	18,266
Rum, gallons ..	1,405,381	669,845	955,138	178,667
Molasses, gallons ...	42,928	None	None	None
Cattle-food (Molascuit tons)	570	260	846	186
Cacao, cwts. ...	20	8	None	None
Citrate of Lime, cwts.	16	44	19	35
Lime Juice, gals. ...	None	None	None	No records available
Essential Oil of Limes, gals. ...	1	None	None	
Coconuts, thousands	751	1,615	716	636
Coconut Oil, gals. ...	5,660	13,689	6,209	9,145
Copra, cwts. ...	654	None	330	184
Coffee, cwts. ...	2,181	989	299	2,859
Kola-nuts, cwts. ...	None	10	None	None
Rice, tons ...	3,979	5,519	None	65,882
Ricemeal, tons ...	29	None	None	None
Cattle, head ...	152	None	None	None
Hides, No. ...	1,200	2,265	839	1,228
Pigs, No. ...	159	None	None	1
Sheep, head ...	7	None	None	8
Balata, cwts. ...	2,293	1,786	3,139	1,558
Charcoal, bags ...	12,015	13,689	11,375	14,134
Firewood, Wallaba, etc., tons ...	2,322	1,063	1,732	1,701
Gums, lbs. ...	248	2,861	7,055	None
Lumber, cub. ft. ...	71,241	40,754	15,706	10,510
Railway sleepers, No.	3,940	3,310	2,614	6,388
Rubber, cwts. ...	45	100	6	None
Shingles, thousands	587	372	242	663
Timber, cub. ft. ...	21,121	14,689	41,567	37,436

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EDITORIAL NOTES.

ALMOST invariably when we happen to think of a suggestion for improving our present industrial and agricultural conditions, we discover on submitting it to analysis that it contains nothing new. The result is usually a restatement of old and well-tried principles. Success is more often due to application of these principles, to enthusiasm, thrift and co-operation. It should be the aim of everyone connected with agriculture, sugar planter and farmer alike, to try and obtain the most out of the material at his disposal. This effort should not begin in the factory but in the field. Better cultivation means greater tonnage and better quality, it also means more employment. It is true that labour conditions in this colony are very difficult, especially at the present time. Under these conditions it will be found that good management and a sense of co-operation are the main factors making for success. It will be necessary to give closer attention to all field operations with a view to economy and also to see that the best results are obtained with the labour available. The question of mechanical tillage at once appeals to one as a means of solving the problem, but unfortunately the results of experiments in this Colony along this line are wrapped in obscurity. The report of the Superintendent of the Sugar Planters Experiment Stations

for the past year, which is here commended to our readers, touches on this question, and therein will also be found many helpful suggestions as to future work.

The need for scientific assistance in dealing with field problems should not be lost sight of. The study of soil conditions must be made with the help of the chemist, and will often result in increased yields. Likewise, the biologist is able to ensure good production by the suppression of injurious insects and fungi. Here the greatest necessity for co-operation is apparent, otherwise his efforts are doomed to failure. We reproduce in this issue a review by that eminent scientist Professor J. A. Thomson, which shows the need for scientific assistance by the farmer, and its perusal is also recommended.

Attention is drawn to the work of Mr. W. N. C. Belgrave on South American Leaf Disease of Rubber. This officer visited these parts whilst on leave about two years ago and paid special attention to this disease.

The article on Grape Culture by the Senior Agricultural Instructor, though brief, is worth reading. We solicit other short articles of a like nature from those of our readers in this colony who have paid attention to some particular form of fruit culture.

The absence of entomological notes in this issue is chiefly due to the promotion of the late Editor of this Journal to the post of Entomologist to the Government of Palestine. During the four years Mr. Bodkin was Editor, there was never any dearth of material of this nature and we trust that arrangements will soon be made whereby their regular inclusion is possible.

ALCOHOL AS MOTOR FUEL.

A PRACTICAL investigation of the behaviour of alcohol in internal combustion engines has been carried out by the Empire Motor Fuels Committee of the Imperial Motor Transport Council, and the results have now been published in an interim report. The principal conclusions of the investigating sub-committee, of which Dr. W. R. Ormandy is chairman, are as follow:

(1) Alcohol can be employed from the low compression employed on paraffin engines up to a far higher compression than can be used on any petrol; (2) the thermal efficiency obtainable with alcohol is higher than with petrol or benzol; (3) under all conditions of throttle or mixture alcohol requires the spark more advanced than is the case with petrol or benzol and much more advanced with the weak mixtures; (4) there was no evidence at any piston speed attained in the engine that the rate of combustion of alcohol under the conditions obtaining was too slow to obtain the maximum effect; (5) detonation does not occur at compressions up to 8-1, and pre-ignition does not occur at 6-1, even when running for long periods at the highest possible power output of the engine; (6) there were no evidences whatever of corrosion in the engine; (7) the power output and efficiency are increased by low temperature of the circulating water; (8) supplying heat to the carburettor reduced the power output but slightly increased the thermal efficiency; (9) increase in the water contents up to 10 volumes per cent. is an advantage, particularly in very high compression engines. A new series of experiments is now in hand with a view to investigating the influence of ether and alcohol, and the influence of alcohol on petrol, benzol, paraffin, and the like. It is believed that this work will prove of considerable value to the motor industry, as it is probable that the first introduction of alcohol on any scale as a motor fuel will be in the form of an admixture of the same with other ingredients.
—*The Chemical Age.*

ANNUAL REPORT ON THE WORKING OF THE BRITISH GUIANA SUGAR PLANTERS' EXPERIMENT STATIONS COMMITTEE FOR THE YEAR ENDING SEPTEMBER 30TH, 1921.

TO THE CHAIRMAN AND MEMBERS OF THE B.G.S.P. EXPT. STATIONS COMMITTEE.

Gentlemen,

The work of the Committee during the year has been confined almost entirely to operations at the Sophia Station, where the selection and extension of varieties already on hand and the production of new varieties from seed has been pushed forward. As explained in the last Annual Report, the Station Sophia was started in July, 1920, with a selection of 640 varieties of seedlings produced at the Botanic Gardens between 1910 and 1918, and covering from 1/150-1/6 acre each and of 2,000 seedlings in single stools, raised in 1919; this selection is being thoroughly worked over for improved sorts pending the production of new varieties by the Station. Accordingly, in May and June, 1921, these canes, being about 10 months old, were selected, drawn down and those sorts occupying the smaller areas extended on the Station while the larger quantities were distributed in proportion among the various sugar firms, who in turn distributed them to one or two of their estates for trial under estate conditions. In all approximately 60 tons of cane tops of the following varieties were divided between Plns. Uitvlugt, Enmore, Diamond, Ogle, Nonpareil, Blairmont, Versailles, Schoon Ord, Hampton Court, Houston and Hope. The varieties distributed were:—

TABLE 1.

Variety.	Parent.	Year pro.	Av. suc. content of juice as comp. with D625 taken as 100.	Purity of juice Hand Mill	Colour of cane.
D49 ...	D419	1913	103	82.7	Greenish purple.
D51 ...	D44	1913	113	85.6	Reddish purple.
D60 ...	D15	1913	118	85.5	Yellowish green.
D100 ...	B'bon	1908	102	84.6	Brownish green.
Jam.71 ..	...	...	105	86.0	Yellow.
Jam.72 ..	...	...	105	86.1	Yellow.
Jam.73 ...	...	...	106	85.6	Green, black bloom.
D133 ...	D317	1913	106	84.0	Rose green.
D281 ...	B'bon	1913	102	82.5	Rose green.
D320 ...	D145	1913	107	88.0	Purple.
D329 ...	D145	1913	99	80.5	Reddish purple.
D335 ...	D145	1913	112	82.7	Yellow green.
D426 ...	D651	1913	111	86.6	Green, black bloom.
D437 ...	D625	1910	113	84.4	Reddish brown.
D458 ..	D651	1913	92	84.3	Yellow.
D461 ...	D625	1910	96	81.9	Yellowish green.
D503 ...	D651	1913	105	83.3	Greenish yellow.
D562 ...	D625	1913	109	86.2	Greenish yellow.
D566 ...	,,	,,	127	88.7	Yellowish green.
D575 ...	,,	,,	112	88.7	Yellowish green.
D600 ..	,,	,,	110	85.9	Yellowish green.
D661 ...	,,	,,	131	88.2	Green yellow.
D662 ...	,,	,,	109	88.5	Green.
D663 ...	,,	,,	105	80.3	Yellowish green.
D667 ...	,,	,,	85	84.5	Greenish yellow.
D671 ...	,,	,,	107	83.6	Yellow.
D673 ...	,,	,,	110	87.8	Yellowish green.
D683 ...	,,	,,	103	87.1	Yellow green.
D686 ...	,,	,,	115	87.4	Green yellow.
D689 ...	,,	,,	102	83.3	Green yellow.
D695 ...	,,	,,	108	85.6	Green yellow.
D708 ...	,,	,,	107	86.4	Green yellow.
D717 ...	,,	,,	105	85.7	Yellow.
D734 ...	D145	,,	101	84.9	Purple.
D735 ...	,,	,,	102	86.2	Purple.
D742 ..	,,	,,	106	88.3	Yellowish green
D747 ...	,,	,,	103	85.2	Greenish purple
D779 ...	D419	,,	103	87.7	Greenish yellow.
D874 ...	D721	,,	95	85.5	Dark purple.
D887 ...	,,	,,	89	81.3	Dark purple.

The estate plots thus obtained will be inspected and selected from time to time and recommendations made as to extension or relegation.

From the selection and extension of the smaller amounts (more recently produced) 370 sorts were planted

occupying an area of 15 acres. The plots thus obtained will be analysed for sucrose content, etc., and selected in due course and tops distributed.

From the 2,000 1919 seedlings none were found good enough to proceed with further and all were relegated.

Meanwhile, commencing October, 1920, new varieties have been raised from seed. As explained last year the number of varieties from which arrows could be obtained was limited to those grown on the estates, as practically all canes had been cut at the Botanic Gardens to plant at Sophia and the Sophia canes were too young to arrow. Accordingly arrows were selected from the fields of various estates, seedlings raised from them, selected for vigour, pricked out into baskets, after a time again selected for vigour and the survivors finally planted in the field. The work of raising the seedlings was conducted simultaneously both at the Botanic Gardens and at Sophia, the selected seedlings from both nurseries being planted out at Sophia.

In all, there were finally planted in the field:

Parent.	*No. of seedlings planted.*
D 625	3,200
D 145	3,300
D 419	1,900
D 118	3,900
Bourbon	400
Green Transparent	700
D 294	500
B 208	100
Jam. 73	70
D 118 x D 95	30
D 367	20

In August, 1921, a commencement was made of raising a further batch of new seedlings. On this occasion the number of parent canes available was much greater and more varied, including 30 old "named" varieties, and a considerable number of seedlings of varied parentage is looked for during the current season.

To provide a sufficient area for the above operations, clearing of new land has proceeded gradually and regularly. During the year 10 fields have been cleared (an area of 30 acres) and the necessary canals dug. The area on September 30th stood as follows:—Planted, 34 acres. Cleared, $10\frac{1}{2}$. In bush, 65.

In addition to this clearing and general cultivation, a watch house was erected near the entrance bridge in November, 1920, a 6-foot greenheart drainage koker installed in February, 1921, and a trench connecting Sophia with Ogle dug in September, 1921. This latter is for the purpose of conveying rejected canes to the factory at Plantation Ogle to be crushed.

In response to requests by the Superintendent, small amounts of new varieties of cane have been received from Barbados, Trinidad, Mauritius, Australia, Egypt, St. Croix, Cuba and San Domingo, and planted in a quarantine area. Messrs. Booker Bros., McConnell & Co., Ltd., kindly presented the station with a small collection of varieties imported from Brazil and Messrs. Sandbach, Parker & Co. kindly presented a selection of canes (selected by the Superintendent) from a large collection raised on their Plantation Providence by Mr. A. E. Bratt.

Consequent on the prevalence and spread of mosaic and other diseases in cane countries abroad, the Committee in January recommended to the Board of Agriculture that the importation of cane cuttings into the Colony be prohibited, except by or through the Botanic Gardens or the Sugar Planters' Experiment Stations and that all canes thus imported be planted in a quarantine area at the Botanic Gardens or under the control of the Sugar Planters' Experiment Stations Committee, thus insuring a close watch on the resultant plants for any exotic disease or pest. An order was subsequently made by the Board of Agriculture embodying the recommendation (Order, August 4, 1921 under section 3 of Plant Diseases and Pests Prevention Ordinance, 1920).

A consignment of BH 10 (12) and Ba 6032 imported by Messrs. Curtis Campbell & Co. from Barbados,

had, by arrangement, already been dealt with in January, 1921, by planting at Sophia. In these cases of importation by firms or individuals the Experiment Station takes over the "tops," plants and cultivates them, and hands over the first batch of the "tops" grown to the importer, successive ratoon crops being the property of the Station.

A small seedling nursery established at Plantation Anna Regina containing over 2,000 seedlings raised during the 1920 season from D625, D145, D419, D118, D570 and BH 10 (12) was, in June, 1921, offered to the Committee by Mr. A. E. Craig on condition that the Committee paid for the subsequent cultivation of it. After inspection by the Superintendent, this was taken over by the Committee in July, 1921.

Seeds of a number of varieties of legumes have been received from several countries and are being tried out on small plots at Sophia and at the Botanic Gardens.

After having visited most of the estates the Superintendent, in June, 1921, submitted to the Committee a report surveying the sugar industry in the colony, and suggesting the lines upon which future enquiry and progress might run.

The Committee recommended and the Sugar Planters' Association sanctioned, in September, 1921, the assessing of the contribution of the estates to the Experiment Station Fund at 10 cents per acre.

In April, 1921, Mr. J. C. Gibson, representing Messrs. Booker Bros., McConnell & Co., Ltd., resigned in favour of Mr. H. Deverill representing the B. G. Sugar Factories, Ltd.

At the end of the year the retiring members were Messrs. R. E. Brassington, A. E. Craig, A. E. Bratt: the two former were re-elected, but Mr. Bratt resigned and was replaced by Mr. G. E. Anderson of Messrs. Sandbach Parker & Co., Ltd.

The personnel of the staff remains unchanged, the Superintendent being the only scientific officer employed.

The cataclysm in the sugar market in the early months of 1921 and the ensuing continued depression has, in this Experiment Station project, as in many others, restrained the progress of inquiry and development. It is particularly unfortunate in this instance where the whole of the development so far undertaken has been in the direction of the production of new varieties of cane.

Important as is this aspect of experiment station work, it is not more so than is inquiry into methods of cultivation and manuring with the object of their improvement, especially as 6 or 7 years must elapse between the production of a variety and the distribution of it to the estates in reasonable amounts. Not that reliable information can be obtained from cultural and manurial experiments in any less time, but the probability of increased crops resulting is at least as great. We have to reflect that the standard cane of the Colony, D625, was produced in 1892, *i.e.*, 30 years ago, and although hundreds of thousands of seedlings have been raised since, no one has been found to supersede it, though several have approximated to it in desirable characters. Not only this, but many of the choice seedlings raised in other countries have been imported and tried against it with results that are well known. This will give some idea of the difficulties behind the problem and some indication of the odds against us.

That a cane will be found to supersede the D625 is undoubted, but that such a cane will be so immeasurably superior as to alter the whole aspect of the industry here is highly problematical. I do not think the D625 is sufficiently appreciated, and while certainly a low purity cane, I believe a good deal of its bad reputation is due to the cutting of immature cane and to some extent to slow handling after cutting. In this matter of varieties the gravest danger lies in the very restricted choice open to the planter: the advent of any serious disease to which the D625 was susceptible would wipe out 75 per cent. of the cane in cultivation. The continual search for varieties is of the

utmost importance, but in the quest for increased crops it will not do to sit down and wait for them, though this is undoubtedly the line of least resistance. Reliance on improved varieties must not be overdone. If we look around at other sugar producing countries we find that the only ones producing bigger crops are those paying closer attention to cultivation operations. The varieties of cane they grow are in many cases old varieties which were abandoned here long ago. With the class of field operation carried out in Java, Hawaii, and similar places this colony could attain yields comparable with theirs. Every planter here is familiar with instances of yields of 3 to 4 tons of sugar per acre, and as our soils do not vary very greatly there is no real reason why these instances should not become more frequent. To me it is surprising that, on soils which have been in continuous cultivation from 20 to 50 years or even more with only one kind of crop, receiving practically nothing but sulphate of ammonia, being disturbed with the fork to no more than 9 inches deep once a year, and in any case limited in depth by a high water table, we get the crops we do.

If crops of sugar around 1.5 to 2 tons can be got under these conditions it seems to me that much bigger crops could be got by more thorough methods. It does not, of course, necessarily follow that the ncrease in crop will of a certainty mean an increase n profit: intensive cultivation is not always a panacea or low prices. The increased attention necessary would mean greater expense in such items as selecting tops, half-banking, forking banks, moulding, manuring and borer control, but even if the increase in crop barely offset the increase in the above expenses the cost per ton of sugar grown would certainly be decreased in such items as sea defence, taxes, maintenance of dams, trenches, drains, pumping, relieving, supplying, planting and weeding since these costs over a given acreage are the same whether the crop raised on it is large or small. The ultimate judge must, of course,

be the balance sheet and upon its verdict must rest the soundness or otherwise of the suggestion. I believe, however, that in any test the economic superiority of more intensive methods would be vindicated. Viewing the proposition from another angle let us take a look at some of the more successful cane growing countries and see what we can learn from them, and let us take as examples Java, Cuba and Hawaii. We may note certain broad general tendencies: in Java, land may be regarded as dear and is restricted in amount while labour is very abundant and cheap. Here "intensive" methods of cultivation are in vogue, the cheap labour being used to the fullest extent to obtain the maximum possible production of sugar from the limited area of land available. In Cuba, land is plentiful, cheap and fertile (being mostly new land), while labour is scarce and dear: in this case we note the prevalence of "extensive" cultivation, large areas being planted and cultivated in a crude fashion by "colonos" or tenant farmers who sell their cane to the factories. In Hawaii, land is fairly dear and labour scarce and expensive though fairly efficient: this country has found its best results to follow "intensive" cultivation by the most modern labour saving implemental methods and the use as far as possible of the "contract" system in which parties of labourers undertake the cultivation of the cane on a given area for an agreed sum. From these cases we note broadly that the problem of dear land is met by "intensive" cultivation and that of dear labour by "extensive" cultivation or the adoption of implemental methods. In British Guiana the actual land is cheap but the necessity for sea defence and drainage of almost absolutely flat heavy lands introduces such high overhead charges as to make it actually dear. From the examples noted above, the inference is again that "intensive" cultivation would make for success here.

The correlation of the labour situation is not, however, quite so clear. Our labour is not quite so dear as in Cuba or Hawaii, but there is little doubt

that with the development of rice farming and of industries in the interior, the situation will become worse and for considerations of the future it would be as well to look upon it as dear. We have, then, left to us cane farming, or economy of labour by mechanical methods. Adoption of cane farming simply means economy of labour by taking advantage of the fact that a man will work better for himself than for an employer. It has not so far been a success here as everyone knows, nor do I consider it will become a success on the coastlands, where the prime essential is close attention to drainage with its attendant expenses. The place for cane farming is farther up the rivers where alluvium with natural drainage might be found.

We have left, then, resort to mechanical means of cultivation. From whatever aspect I endeavour to visualise progress in cane cultivation in this colony, I inevitably arrive at the need of "power farming." It is nothing short of calamitous that financial stringency should have necessitated the abandoning by almost every estate of their trials in this direction. I would strongly advocate a resumption of these as soon as it is possible to do so. As I have elsewhere advocated, trials should be carried on co-operatively and as the matter will be of importance to every other class of agriculture on the coastlands, it should be heavily subsidised by Government. In the same place I have also outlined the problems to be solved in this connection and will not labour the matter further here.

With labour at present prices it may be possible still to work more intensively by hand methods, though of course over a smaller area. It is to be hoped some of the larger estates will take up the point and try out 50 or 100 acres on a more intensive scale, picking tops more carefully, forking deeper and draining deeper. Weeding should really be done by the hoe to get a mulch at the same time, but I doubt if this would pay by hand on heavy soils. The use of more intensive methods may well alter the manuring problem by enabling the plant profitably to utilise larger amounts.

of manures, but this could only be decided by regular trials. It would probably also profoundly alter the cane variety problem. The varieties in cultivation are characterised by low sucrose but great hardihood. That a cane of great vigour should be demanded is in itself an admission that the methods of cultivation are not what they might be. No other country has so far got any use for our standard varieties. Great vigour and high sucrose are apparently antagonistic, at least no one yet has found them associated.

While the search goes on it would be far better to use a moderately sweet cane of moderate vigour grown under more favourable conditions. Such varieties are not difficult to produce and it is probably such canes that will supersede the D625.

In these notes I have endeavoured to point out that to develop the industry here something more is needed than a search for new varieties. The drop in prices has made it quite evident that all is not well on the sugar estate. The large sums invested in machinery during the past few years have vastly improved the factory end of the business, but cane is dear and field methods remain substantially, and in many cases in detail, what they were 30 or 40 years ago. The conditions under which these methods were worked out were different from what they are to-day mainly in regard to labour, but also in relation to possibilities of improving manuring, drainage and irrigation. To put the industry on a sound footing every operation needs to be analysed critically from the ground up: this is the job of the modern experiment station and it is to be hoped that with the advent of paying prices it will be possible to strengthen the existing experiment station scheme to enable this to be done, a manifest impossibility at present with a single scientific officer on whom devolves both direction and routine.

Respectfully,

JAS. CRABTREE,

Superintendent.

BRITISH GUIANA SUGAR PLANTERS' EXPERIMENT STATIONS COMMITTEE

STATEMENT SHOWING TOTAL RECEIPTS AND EXPENDITURE FOR YEAR ENDING 30TH SEPT. 1921.

RECEIPTS.

Balance 1919-1920	$ 2,711 95
Assessments on Sugar Estates	68,162 00
Government contribution in lieu of assessments on cane farmers	300 00
Refunds on Motor car (Superintendent)	600 00
Interest on Savings Deposit	627 70
Sundry receipts	8 94

PAYMENTS.

Management.		
Chairman	$1,000 00	
Secretary	480 00	
Superintendent (salary)	3,918 00	
,, (house)	720 00	
Field Manager	1,440 00	
Other Salaries	755 00	
Travelling	866 78	9,179 78
SOPHIA.		
Wages.		
Tillage	4,585 03	
Manuring	52 52	
Other Field	1,139 68	
Reaping & Transporting	752 34	
Navigation	563 06	
Drainage & Irrigation	685 17	
New Land	2,207 24	
Seedling Nursery	1,075 69	
Dwellings	214 43	
Sundries	764 21	
Laboratory	4 80	
Office	5 00	12,049 17

Expenses.		
Rent	1,159 25	
Manures	457 68	
Other Field	30 65	
Reaping & Transporting	10 08	
Navigation (punts, etc.)	409 80	
Drainage & Irrigation (kokers, etc.)	624 03	
Seedling Nursery	194 98	
Dwellings (building materials, etc.)	974 34	
Sundries (tools, stores, etc.)	577 76	
Laboratory	57 42	
Office (Stationery, typewriter, etc.)	489 25	4,985 24
Total payments		26,214 19
Balance in Colonial Bank, current account		103 07
Balance in Colonial Bank savings deposit		44,611 44
Balance in Colonial Bank Superintendent & Secretary a/c		1,422 95
Petty Cash on hand (Secretary)		25 00
" " " " (F. Manager)		33 94
Total..........		$72,410 59

Total.............$72,410 59

RESUMÉ OF MINUTES OF THE BRITISH GUIANA SUGAR PLANTERS' EXPERIMENT STATIONS COMMITTEE.

The British Guiana Sugar Planters' Experiment Stations Committee met on 13th March, at the office of the Director of Science and Agriculture, when the following were present: Mr. W. Francis, F.I.C., Acting Director of Science and Agriculture, Chairman, Hon. R. E. Brassington, Messrs. A. E. Craig, G. E. Anderson, H. Deverill, Jas. Smith and the Superintendent and Secretary.

The Superintendent's Report for the previous month was discussed and matters in connection with the transportation of canes to Ogle Factory were considered.

The Committee visited the Sophia Station on the 10th April, when the following attended: Messrs. W. Francis, Chairman, G. E. Anderson, H, Deverill, Jas. Smith, A. E. Craig, Hon. R. E. Brassington, with the Superintendent, Field Manager and Secretary. The Committee expressed their appreciation of the very satisfactory condition of the cultivation and the station as a whole which reflected great credit on the officers in charge.

On the 8th May, the following attended a meeting of the Committee: Messrs. W. Francis, Chairman, H. Deverill, G. E. Anderson, A. E. Craig and C. Farrar, the latter having been appointed as a member of the Committee in place of Mr. Shields, who had left the colony. The Superintendent's recommendation for the purchase of a portable pump for irrigating and draining small sections of the station was favourably considered.

The Committee met again on the 12th June, when there were present Messrs. W. Francis, Chairman, G. E. Anderson, A. E. Craig, C. Farrar and the Superintendent and Secretary. Letters from the Field Manager of Sophia and the District Engineer of the Public Works Department with reference to the putting in of a stop-off in the

Cumings canal were read. Mr. Craig explained in some detail the very unsatisfactory condition of the drainage of Plns. Ogle and Bel Air *cum annexis*. This meeting was adjourned until the 26th June when the following were present: Messrs. W. Francis, Chairman, G. E. Anderson, A. E. Craig, H. Deverill, C. Farrar and the Superintendent and Secretary. The Annual Report of the Superintendent on the working of the Stations was discussed. The Superintendent, in reviewing the situation, stated that many experiments had been tried from time to time by the sugar planters as regards methods of cultivation, but unfortunately the results were not available to the majority. The duty of the experiment station was to carefully record the results of their experiments in order that they might be available to everyone. The members present agreed that there was room for improvement in this direction, and requested the Superintendent to submit a scheme for the further development of the Experiment Station's activities for consideration by the Committee at its next monthly meeting.

THE PRINCIPAL VARIETIES OF SUGAR CANE UNDER CULTIVATION IN BRITISH GUIANA DURING 1920, 1921, 1922.

By the Director of Science and Agriculture and the Secretary of the British Guiana Sugar Planters Experiment Stations Committee.

The following table shows the areas occupied by the principal varieties of canes under cultivation for the crop of 1922 compared with those of 1920 and 1921.

AREAS IN BRITISH ACRES.

Variety.	1920	1921	1922	Increase or decrease on 1921.	
	Acres.	Acres.	Acres	Increase.	Decrease.
D 625	36,100	37,240	37,707	467	...
Bourbon	2,926	2,337	1,609	...	728
D 625 mixed with Bourbon and other seedlings	8,561	9,150	6,819	...	2,331
D 145	5,183	4,935	4,601	...	334
D 118	3,608	3,152	2,573	...	579
B 208	3,118	2.254	1,919	...	335
D 419	1,887	1,688	1,007	...	681
R.P. 8	563	891	854	...	37
Diamond 185	1,174	861	648	...	213
Green Transparent	976	752	512	...	240
D 109	470	297	326	29	...
Ba 6032	155	210	269	59	..
Java Seedlings	903	682	232	...	450
B H 10 (12)	69	131	207	76	...
Diamond 37	130	132	188	56	...
R P 29	18	55	107	52	...
D 167	123	99	89	...	10
Diamond 581	7	12	75	63	...
D 4395	67	66	66	...	...
B 376	344	206	63	...	143
R P 21	119	67	61	...	6
D 179	60	60	50	...	10
P L 2	...	13	45	32	...
B 147	101	87	37	...	50
B 6450	47	39	32	...	7
D 199	3	30	32	2	...
P L 374	20	29	30	10	...
Small areas of other varieties and areas under varieties unenumerated	756	403	438	35	...
Totals	67,488	65,869	60, 596	831	6,154

The following table indicates the relative distribution of the various kinds of cane during the crops of 1918, 1919, 1920, 1921 and 1922 :—

Variety.	For Crops of				
	1918	1919	1920	1921	1922
D 625	47.9	46.2	50.9	56.5	62.2
Bourbon	6.4	4.7	4.1	3.5	2.7
D 625 mixed with Bourbon and other seedlings	10.2	10 2	12.1	13.9	11.3
D 145	7.7	6 3	7.3	7.5	7.6
D 118	3.5	3.6	5.1	4.8	4.3
B 208	5.9	4.8	4.4	3.4	3.2
D 419	1.8	2.3	2.7	2.7	1.7
Providence 8	0.5	0.7	0 9	1.6	1.4
Diamond 185	1.5	1.1	1.7	1.3	1.1
Green Transparent	1.7	1.5	1.4	1.1	0.8
D 109	0.4	0.5	0.7	0.5	0.5
Java Seedlings	0.8	0.7	1.4	1.0	0.4
Ba. 6032	0.1	0.2	0.2	0.3	0.4
B H 10 (12)	...	...	...	0.2	0.3
Diamond 37	...	0.1	0.2	0.2	0.3
Other varieties unenumerated ...	11.6	16.7	6.9	1.5	1.8
	100.0	100.0	100.0	100.0	100 0

From the returns supplied by the sugar plantations, the distribution of the various sugar canes in cultivation for the crops of 1918, 1919, 1920, 1921 and 1922 according to their origin are as follows :—

	1918	1919	1920	1921	1922
Bourbon and other old varieties	13.0	13.1	8.9	8.8	8.5
Java	0.8	0 8	1.4	1.1	0 4
Barbados	6.7	5.9	5.7	4.4	4.3
British Guiana :—					
Plns. Diamond and Providence	2.6	2.6	3.2	3.3	3.3
Botanic Gardens	76.9	77.6	80.8	82.4	83.2
	100.0	100.0	100.0	100.0	100.0

The average yields in tons of commercial sugar per acre of the principal varieties under cultivation for the crops of 1921, as deduced from the returns supplied by the managers of the sugar plantations, were as follows :—

CROPS OF 1921.

	B 208		D 145		D 419	
	Yields	Acreage.	Yields	Acreage.	Yields	Acreage
Mean of all plantations ...	2.11	2,055	1.94	4,233	1.87	1,018
Maximum reported ...	2.88	179	2.78	6	2 67	6
Minimum reported ...	1.38	12	1.31	13	1.32	70

	D 625		G Trans.		Mixed	
	Yields	Acreage	Yields.	Acreage	Yields	Acreage
Mean of all plantations ...	1.86	28,405	1.86	216	1.81	8,201
Maximum reported ...	3.09	792	2.69	52	2.93	217
Minimum reported ...	0.68	439	1.52	13	1.19	252

	D 118		Bourbon.		<> 185	
	Yields	Acreage	Yields	Acreage	Yields	Acreage
Mean of all plantations ...	1.79	2 961	1.73	1,826	1.73	646
Maximum reported ...	2.63	183	3.14	200	2.18	473
Minimum reported ...	1.21	487	0.59	10	1.39	140

	Java		Ba. 6032		B. H. 10 (12).	
	Yields	Acreage	Yields	Acreage.	Yields	Acreage
Mean of all plantations ...	1.52	619	3.10	25	2.56	884
Maximum reported ...	1.80	3	3.20	20	3.00	11
Minimum reported ...	0.94	266	3.00	5	1.78	768

	D 167		B 147		B 6450	
	Yields	Acreage	Yields	Acreage	Yields	Acreage
Mean of all plantations ...	2.15	92	2.08	157	2.04	26
Maximum reported ...	2.80	10	2.60	112	2.28	19
Minimum reported ...	1.85	55	1.55	45	1.80	7

	P L 2.		D 109		D 179	
	Yields	Acreage	Yields	Acreage	Yields	Acreage
Mean of all plantations ...	1.85	14	1.81	173	1.77	34
Maximum reported ...	1 93	6	2.39	60	2.00	10
Minimum reported ...	1.77	8	1.34	31	1.53	2

The following tables indicate similar figures as the preceding, but they are compiled from the returns supplied by the larger plantations only.

	B 208		Bourbon		D 625	
	Yields	Acreage	Yields	Acreage	Yields	Acreage
Mean, larger plantations only ...	2.11	2,055	2 10	836	2.06	21,242
Maximum reported ...	2.88	179	3.14	200	3.09	792
Minimum reported ...	1.38	2	1.20	27	1.25	1,041

	D 145		G Trans.		D 419	
	Yields	Acreage	Yields	Acreage	Yields	Acreage
Mean, larger plantations only ...	2.06	4,115	2.01	185	1.87	1,018
Maximum reported ..	2.78	6	2.69	52	2.67	6
Minimum reported ...	1.33	148	1.66	15	1.32	70

	D 118		<> 185		Java	
	Yields	Acreage	Yields	Acreage	Yields	Acreage
Mean, larger plantations only	1.84	2,792	1.73	646	1.52	619
Maximum reported ...	2.63	183	2.18	473	1.80	3
Minimum reported ...	1.21	487	1.39	140	0.94	266

The results of large scale field-trials with other varieties on the sugar plantations are shown in the following table :—

VARIETY.	ACREAGE.	YIELD.
Diamond 581	11	2.73
R P 8	847	2.71
P L 264	20	2.65
B 3412	31	2.62
Diamond 37...	127	2.55
P L 374	19	2.43
D 433	8	2.30
Diamond 35	13	2.23
P L 254	20	2.22
D 216	20	2.18
R P 23	22	2.05
R P 73	30	2.05
B 376	149	2.00
R P 21	65	1.96
R P 20	86	1.91

SCIENCE AND THE FARMER.

PROFESSOR J. ARTHUR THOMSON, M.A., LL.D.,

University of Aberdeen.

THE makers of new science have often been reproached for thinking more of knowledge for its own sake than of "the relief of man's estate." That this reproach is in general unjust may be proved by an appeal to history, for it is quite certain that most of the more striking inventions that have profoundly changed the life of man have sprung from very abstract researches. First light, and then fruits, as Bacon said. The search for *Principles* always pays. But there is another answer to the unjust reproach, and that is to point to the ever-increasing body of new knowledge which has direct practical applicability and yet is left unutilised. A perusal of the stimulating Report which Mr. V. E. Wilkins has recently drawn up for the Ministry of Agriculture* shows what a wealth of useful knowledge there is which is not in general circulation: for here we find scores of discoveries of obvious practical value to the farmer which are not being applied except by a few. This is partly because we are in many departments of life in process of transition from the empirical to the scientific; it has not become natural to the farmer to seek expert advice except from the veterinarian. It is all too characteristic of the Briton to stick to methods that yield *tolerable* results, instead of pressing on to new-fashioned ways which promise something much better. Another reason for this Gallio-like indifference is that in days past valuable research was often, as it were, tied up in a napkin of technicality and hidden in the ground of a blue book. But we have changed all that.

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*Agricultural Research and the Farmer. A Record of recent Achievement. Published by H.M. Stationery Office, Imperial House, Kingsway, W.C.2. Price 2s. 6d. net; obtainable through any Bookseller or direct from the Publisher.

The record of recent scientific achievement which Mr. Wilkins has written is as clear as crystal and as interesting as a novel. It is a hand which science stretches out and it is for the farmer to grip it. When he does so he will find his reward.

The philosophy of the subject is plain. The nation's higher progress (in the life that is more than meat) depends on improved health and increased wealth. But more wealth means greater command of the resources of nature, and the chief of these is food. The farmer is the fundamental food-producer, and thus progress largely depends on him. But British Agriculture is passing through hard times, and therefore Science steps in with suggestions which will enable the farmer to get better results with less expenditure of time and energy. We grant at once that other remediary measures are necessary, but here is an obvious one—how to be wealthy by being wise! Everyone wishes to succeed, to get some way on, to have production speeded up; and the Ministry of Agriculture meets this desire with the suggestion—"Try some of our patent scientific levers." It is a fair offer and one that may be trusted. Even if there be a difference between what can be done in the station at Rothamsted and what can be done on a farm at Rothiemurchus, it is for the farmer to meet the scientist frankly and show where the hitch is. Empirical lore is often marvellous, but it will lose nothing by joining hands with scientific research. Indeed, it is sure to gain.

Let us take a few instances of the new knowledge which promises new power. The soil is fundamental, of course, but the days of soil fatalism are long since past. To Dr. Russell and his school we owe a knowledge of the ways of making the soil young again when it grows exhausted, and of making it whole when it turns sick. For the soil is living to a degree that Liebig never suspected. Farmyard manure is becoming scarcer—thanks to motor transport—but there is plenty of straw. So the bacteriologist steps in and harnesses two kinds of bacteria to the task of rotting the straw. How well they do it may

be inferred from the fact that an experimental plant has been devised capable, it is believed, of turning out 2,000 tons of straw manure per annum, at a cost probably under £500. This is just one example out of many; we might refer to experiments on green manure, on making crumbly soil, and on curing acidity. We would rather emphasise the stimulating idea of scientific control. Tilth is something of a mystery; analyse it—discover what it actually means, physically and chemically—and a new day dawns: it can be controlled. The new work has also brought into prominence, as we said, a new idea :—"The soil is no longer looked upon as an inert mass of mineral particles; it is a great living complex, teeming with countless millions of living things each struggling for existence, and each having some influence on those complicated chemical changes on which the growth of all plants depends, and which in the course of ages have turned a stratum of bare rock into something approaching a vast chemical laboratory."

Just as the synthetic chemist has been like a conjuror shuffling the cards of Carbon, Hydrogen, Oxygen, Nitrogen, and so forth, and producing the most extraordinary "hands" or novel carbon-compounds; so the breeder, since Mendel taught him the trick, has been able to produce new combinations which have made the world richer. Metaphorically he grafts on new characters of value and prunes off old characters that are detrimental, and so we get Yeoman wheat from Professor Biffen of Cambridge, Plumage Archer barley from Mr. Beaven of Warminster, and Blue Cone wheat from Professor Percival of Reading. We may almost speak of the creative biologist, though he is really not more than the architect of the materials which are provided by Nature. "A wheat giving a slightly increased yield, or better able to withstand the weather conditions of this country, puts money in the pockets of the farmer, and by increasing home production and thereby lessening our dependence on the foreigner, is a national asset." The story of plant breeding is a romance, but it is also

a recipe-book for getting rich. Take one of the least sensational inquiries, the Welsh study of the kinds of oats suited for different altitudes. There are varieties in common use among the farmers, but these turn out to be mixtures of different strains, and therefore apt to be disappointing. What the Aberystwyth Station is doing is separating out these strains and selecting the best, which will then form the material for further improvement by breeding. When this is done each farm will be able to secure the seed best suited to the local conditions. The same thing is being done with the more intricate problem of pasture grasses.

With a better understanding of the soil is associated a better understanding of the living plant, and botany comes to the farm, inquiring into the factors influencing crop yield, the meaning of the mysterious quality of immunity to fungoid disease, the possibility of stimulating cereals with electricity, and so on down to details like the cause and cure of the "mealiness" which develops in apples and pears that have been stored too long. It is safe to predict that in years to come the farmer and the physiological botanist will be close friends, with much to say to one another. There is the plant-pathologist too, with his advice on "finger-and-toe," potato "scab," "bunt" in wheat, and all the terrible list of plant-diseases, including, of course, those like "big bud" which are due to animals. Progress towards eradication and prevention seems to be very slow; but the life-histories of many pests are being unravelled and control is bound to follow. What has been achieved (we do not think the word too strong) of recent years is outlined in Mr. Wilkins' report; we wish to emphasise the fact (commonplace, if you like, yet not vividly recognised) that *the days of submission to disease are over*. The Research Institute on Plant Pathology at Rothamsted is, we understand, able and willing to act like a medical advisory centre diagnosing disease, and suggesting such remedies as the state of science can conscientiously recommend. In all this there is great gain. There is a socialising of science (perhaps more advanced

in agriculture than in any other field), and there is a transition from empirical lore, of which we speak appreciatively, to scientific control.

This country is deservedly famous for its cattle and sheep, but there is no reason to believe that the output of meat is anything like what it might be. Moreover, the bill for imported feeding stuffs is far too heavy, amounting in 1919 to nearly sixty millions sterling. Hence the importance of the Animal Nutrition Institute at Cambridge and the Rowett Research Institute at Aberdeen. Nothing but patient experiment can determine what protein foods, for instance, are most profitable, and what proportions are best. An excess may be positively injurious as well as wasteful. Only in well-equipped institutes can security be reached in regard to such a subtle thing as digestibility ; and the energy requirements of an animal can only be guessed at without the use of a calorimeter. We have personal experience to help us in regard to our own energy-requirements and capacities for digestion, yet we are continually making mistakes ; how much more likely are we to err in regard to stock into whose feelings we cannot enter !

Another question of profound interest concerns the minute "accessory food substances" or vitamins which are known to play an essential part in the health of man and beast. The subject is still very young, but it seems that cases of slow growth, digestive troubles, and lack of vigour are sometimes due to monotony and artificiality of diet. Thus the Cambridge workers shewed that rye alone was an entirely unsatisfactory food for young pigs, but was thoroughly wholesome when supplemented by a handful of grass per day. Similarly, the Aberdeen workers found that the so-called "rickets" of pigs depends not so much on a deficiency of vitamins, as on a lack of mineral matter. All these questions are intricate; they demand scientific precision; but they all mean money, and even on this ground only they are more than welcome.

There is, however, reproduction as well as nutrition to be considered in enlightened animal husbandry. The see-saw of life is between the two. Thus there are important researches in progress which are inquiring into the occurrence of "heat" in young heifers, into the factors controlling the formation of milk, and into the wastage of reproductive activity that is apt to occur in such domesticated animals as pigs, sheep, and rabbits.

The Mendelian experimenters, in Cambridge in particular, continue to give most of their attention to such types as rabbits and poultry, for these are relatively inexpensive and breed rapidly. When secure conclusions have been reached on the phenomena of heredity in these cheaper types, they will be applied to cattle and sheep. There is, of course, much knowledge already available, and it is rapidly increasing. If the farmer wishes to know how to prevent the occasional recurrence of red calves in his highly-pedigreed Aberdeen-Angus breed, he has only to apply to the Mendelian expert, or to think out Mendelism for himself. Or if the poultry-breeder wishes to tell *at hatching* the sex of his chicks, there is no difficulty in doing this when silver hens are mated with gold cocks, and in several other cases. There is money here too, for the breeder can kill off his unwanted cockerels at hatching, and near double the number of pullets with the same plant. It is impossible to conceive of farmers not being interested in the clearly-expressed indications which Mr. Wilkins gives of the breeding-researches in progress in centres like Cambridge and Edinburgh, e.*g*., the endeavour to improve the quality of Blackface wool, or to sift out coloured hairs from the fleece.

With healthy stock there is always something doing, but sickness blots out the sun. So we turn with expectation to the section of "Agricultural Research and the Farmer," which deals with animal diseases. There we find, as we knew we should, that science continues to tackle the hydra-headed monster which seems never to accept defeat. Thus the Royal Veterinary College in London has been experimenting with a vaccine treatment

of the "joint-ill" which carries off many young foals; with a serum treatment of contagious abortion in mares, and with contagious inflammation of the udder in cows. Needless to say, solutions are not picked up like blackberries, but the point is that the days of folded hands are quite over, and that the conquest of disease goes on.

Just as the Aberdeen investigators of "Isle of Wight" disease in hive-bees recently had their reward in the discovery of a trachea-blocking mite, so in regard to other parasitic diseases of other and larger domesticated animals there is progress to report. Thus there has been a successful clearing up of the life-history of the round-worm which causes scouring in sheep and of another which lives in the intestine of fowls. It is very much to be desired that something definite should be discovered in regard to the lamb tapeworm, which appears so soon after birth. Its life-history seems to be peculiarly difficult, and here is a case where co-operation between sheep-farmer and parasitologist might yield results of national value. We cannot afford to leave any important parasite in the dark.

We have not nearly "sampled" the whole of "Agricultural Research and the Farmer"; we have not touched, for instance, on the chapters dealing with fruit-growing and with dairying. We hope we have said enough in our appreciation to excite some interest and expectancy. Frankly we must confess to some enthusiasm over this record of scientific achievement, for we had not quite realised the cumulative effect of a multitude of new researches all converging on "the relief of man's estate," as Bacon phrased it. The biological control of life is here in progress before our eyes; and we submit that it should make the eyes of the farmer glad.

Here is a treasury of new knowledge and the Open Sesame is half-a-crown to His Majesty's Stationery Office. We have not had more interesting or more cheerful reading for many a day than this story "Agricultural Research and the Farmer." It was, if an outsider may

say so, a happy thought on the part of the Minister of Agriculture to devise such a record, and it has been accomplished by Mr. Wilkins with masterly workmanship. We should like to suggest several ways in which its value might be brought home to the farmer.

(1) We are not fond of the saying "seeing is believing," but perhaps the reality of the new researches would be more widely appreciated if there were more opportunities for visiting the Experimental Stations to see things actually happening.

(2) Perhaps more might be made of the Shows and Conferences, where results could be exhibited so that he who runs might read.

(3) No one would wish to interrupt a maker of new knowledge, but there is no doubt that an address from one of the discoverers about his own discoveries is very highly appreciated and never fails of far-reaching effect. It might not be altogether detrimental to the discoverers themselves if such educational excursions were less rare. We know, of course, the splendid expository work of the Universities, Colleges, Stations, and County Organisers, but there is incalculable value in personal contact with the men who are actually making the new science. The Lieutenant is often admirable, but the farmers wish to meet the General. It is in such meetings that some enthusiasm is created, which may lead, for instance, to symposia in which the farmers can thrash out things for themselves, perhaps with a Professor of Agriculture as a referee.

It is impossible to think of a winter-afternoon exercise more profitable intellectually and pecuniarily than going through a book like "Agricultural Research and the Farmer." And it adds to its own merits by giving a guide to detailed literature.

It often looks as if there were some serious flaw in the connections which should bind the scientific expert and the farmer in co-operation. Perhaps this is in part due to the superiority of the pioneer scientists who queered

the pitch by finding no place for the empirics, who retaliated by having no use for them! The day for this is past. In many cases the empirics were and are quite marvellous, sometimes reminding one of physicians born with a flair for diagnosis. All the surviving lore of the old farmers is valuable, as long as it is not superstitious. Yet it requires to be rationalised and illumined, and the long and short of it is that *scientists and farmers cannot afford not to join hands.* In active co-operation in the quest for new knowledge mistrust will disappear and mutual appreciation will grow.—*Journal of the Ministry of Agriculture, Great Britain and Ireland.*

IMPORTATION OF SAANEN GOATS.

The Government Veterinary Surgeon writes:

Some time ago, the Superintendent of the Leper Asylum requested the Board of Agriculture to import goats from Barbados for that institution. The Board at once communicated with the Barbados Government, who deputed Mr. Thorpe their Veterinary Surgeon (who is a great goat breeder himself), to purchase for us. When last I was in Barbados I had an opportunity ogether with Mr. Thorpe of inspecting a few very good milkers. A month ago, the Government of Barbados was able to fulfil our order and shipped one billy, two nannies and a kid. These goats (Saanen) are very deep milkers, but require to be hand fed, when they will produce 10 to 12 pints of milk a day. I would advise anyone who purchases some of these goats to build a wooden platform four feet above ground for them, as they cannot stand the damp. Give a liberal feed and groom them thoroughly every morning. I have a nice nanny for sale at the present moment.

A. SETON MILNE,
Government Veterinary Surgeon.
June, 1922.

NOTES ON THE "SOUTH AMERICAN LEAF DISEASE" OF RUBBER.

By. W. N. C. Belgrave.

Mycologists have repeatedly pointed out the serious results which might follow wide spread attacks of leaf diseases of rubber. While plantations in Malaya have been, so far, happily free from such troubles, reports received in 1918 and 1919 of extensive damage to South American plantations made it desirable that an officer of the department should visit and become familiar with the disease thus ensuring recognition at the earliest possible moment should a local outbreak occur.

The writer visited Trinidad and British Guiana in November, 1920, and the following notes are taken from the report submitted to the Goverment giving the results of that, visit.

History of the Disease.

The first mention of the disease as such is to be found (*a*) in the Journal of the Board of Agriculture, B., G. Vol. VI, No. 3, January, 1913, and is a review of a paper by Kuijper in Bulletin No. 28, 1912, of the Surinam Department (Dept. v. h. Landbouw) in which the trouble is attributed to *Fusicladium Macrosporium*. The disease is said to attack only weak trees and to be, on the whole, not serious. Young leaves are attacked, and infected trees may be found on plantations all over Surinam, even those in virgin forests 38 miles from the Coast. The native wild rubber *Hevea guyanensis* is also attacked and six year old trees have been killed. The fungus is difficult to grow in artificial culture.

(*b*) In July, 1913, Bancroft (*ibid* VII., 1) states that a fungus apparently of a new species has recently been recorded in the Colony on nursery beds, and points out the necessity for destruction of diseased material

before planting out; he recommends lime sulphur spraying. The fungus was subsequently identified by Massee as *Passalora heveae.*

(*c*) That the disease was not seriously regarded may be gathered from a minute by the then Governor Sir Walter Egerton, reprinted in J. Bd. Agric. IX, 1 November, 1915. Drawing on his Eastern experience, His Excellency predicted a healthy future for the industry in British Guiana and anticipated no trouble from disease.

(*d*) By the middle of 1916 the situation had changed for the worse and Bancroft published a long article in the Official *Gazette* No. 228. He states that cultivated Para rubber was first imported in 1895 from Kew, in 1896-99 from Trinidad, and for the past seven years annually from Singapore. Importations have also been made by private individuals from Ceylon, Trinidad and Dutch Ghiana. The area under cultivation(1916) is 4,687 acres of which 1,155 acres was on coast land, 2,854 on the banks of the Demerara and Essequibo rivers and 678 in the N.W. and Pomeroon districts. The soils vary from heavy clay, through medium loams with loose surface and much organic matter to undulating laterite further inland. In a brief review of previous literature Bancroft notes that in 1904 Hennings described three rubber leaf fungi in Brazil: *Dothidella Ulei, Aposphaeria Ulei* and *Phyllachora Huberi.*

In 1908 an undescribed leaf disease was reported in Surinam and in 1909 a leaf disease, the symptoms of which resembled those of the present disease, occurred in British Guiana on trees from Singapore seed. These trees recovered but were again attacked in 1911, when the Economic Biologist got infections to healthy trees. In 1913 the present disease was seen on this plantation by Bancroft and has been present ever since.

Closely similar to the leaf disease of Dutch Guiana disease and the Brazilian *Aposphaeria,* the British Guiana disease has at the time of writing (1916) spread over the

whole Colony except the Essequibo Coast and the greater part of the Demerara Coast. There is no record of the disease on the 30,000-50,000 plants in the Georgetown Gardens. (Most of these are seedlings. The Gardens are in the Coastal area W.N.C.B.)

Trees six years old and 50 miles from any other Hevea plants have been attacked. Die-back (Diplodia) is believed to cause much secondary damage. The mycelium of the fungus is confined to limited area below the points of inffection, and attempts to grow it in artificial media have failed. The disease is more prevalent the larger the area under cultivation and the more humid the atmosphere. The apparent lack of connection between heavy rainfall and prevalence may be due to the possible discrepancy between recorded total rainfall and high humidity. In the N.W. district during a recent prolonged drought the disease was worse, while on the Mazaruni it is now more prevalent in wet weather. The disease has been found on *Hevea confusa* and *H. guyanensis* and on no other wild plant. Spraying when leaves are $1\frac{1}{2}$-$2\frac{1}{2}''$ long is suggested, also burning of fallen leaves and destruction of wild *Hevea* plants.

(*e*) In the Official *Gazette* No. 2 of 20th January, 1917, Bancroft gives an account of a visit to Surinam. He states that the disease is rampant and much more serious there than in British Guiana though climatic conditions are very similar. The total area under cultivation is about 2,400 acres mostly interplanted. When first noted the disease as in British Guiana was sporadic and did not appear likely to become epidemic till 1914. The majority of plantations are badly affected and trees of all ages are attacked and dying, in some cases losses of one-third the total planted have been sustained. The fungus is a native of Peru, Brazil, Guiana and probably Trinidad, and attacks always start sporadically on plantations. In view of the proved travelling powers of spores, destruction of wild Heveas entailing as it does great expense, can no longer be advocated, and spraying has not proved to be effective. Suggestions for the simultaneous defoliation of large areas by 'smoking' or 'gassing' are made.

(*f*) A full description of the fungus and its method of attack has been given by Stahel in Bull. No. 34, January 1907, Dept. v.d. Landbouw in Surinam in which the fungus is named *Melanopsammopsis Ulei* n. gen. (A translaticn of this paper is available in the Mycological Library, Department of Agriculture).

Personal Observations and Present Position of the Disease Trinidad.

In Trinidad the disease was found in a flourishing condition on a nursery bed of 5-7 months old seedlings. The bed was in good condition, not overcrowded, and well supplied with water. Nearly every plant was attacked and almost all the original stem tips had broken off, the attack starting on very young just opened leaves and gradually involving the stem tip.

The attack may cause wrinkling of the margin or spotting of the leaflets, in the former case death and leaf-fall soon follow, in the latter the leaflets may survive. The spots are at first dark on the light transparent back-ground of the leaflet, becoming later light on the dark green ground, still later the diseased patches fall out, giving the leaflets a shot-riddled appearance.

Conidia are produced only in the early stage of attack, followed later by pycnospores and ascospores produced in stromata which form black star-shaped pustules on the older leaves, giving these a most characteristic appear-ance, difficult to figure or describe adequately but quite unmistakable once seen. The writer has never seen any-thing even distantly resembling this disease in the Federated Malay States.

Close to the diseased nursery bed in the Gardens was a field of very badly grown old rubber with signs of con-siderable over-tapping in the past. None of these trees showed signs of attack. The Acting Director of Agricul-true informed me that he had seen the disease on a plantation and in one case on urtapped trees.

British Guiana.

No recently attacked leaves were seen in British Guiana. This freedom from the disease was apparently due to a prolonged dry spell. The shot-hole appearance of attacked leaves was noted and considerable information of a practical nature gathered.

Aspects of the Disease Affecting the Federated Malay States.

The incidence of South American leaf disease is governed by the following facts (*a*) only one of the three spore forms—the conidial—is capable of reproducing the fungus.

(*b*) The conidia are short lived, possessing no power of resistance;

(*c*) The fungus is, as far as is known, a pure parasite;

(*d*) Infection can only take place on very young leaves.

There must therefore be an almost continuous supply of fresh young leaves for the disease to flourish. It happens to be the case in Guiana (and presumably throughout South America) that wintering is not sharply defined as in the Federated Malay States but is spread out over the whole year Only in abnormal years such as 1920, does a drought cause nearly simultaneous wintering, following which the disease is much reduced, as noted above.

It seems highly improbable that the fungus with its non viable spores could ever be accidentally introduced into the East, or that if introduced it could do any appreciable damage owing to our sharp wintering season, *provided the life-history remained unaltered.* There is, however, no certainty that such alteration would not occur as a result of changed conditions, and should, say the ascospores become functional and be enabled to tide the fungus over unfavourable seasons irreparable damage might be done. It is therefore, suggested that the present quarantine restrictions on import of rubber 'plants' be extended to include the whole of the Western rubber growing area.

IMMUNITY.

The much greater damage done by the disease on plantations as compared with jungle trees is believed by some authorities to be due to the fact that the present sparsely distributed wild Heveas in South America represent a small immune or partially immune band of survivors from a much larger original population. Others attribute the difference to mass infection on plantations, and this appears more likely to be the current view, since,

(*a*) the trees on plantations are the quite recent offspring of exhypothese immune trees;'

(*b*) the disease appears sporadically and becomes progressively serious on any plantation;

(*c*) as the mycelium is closely confined to the points of infection on the leaf, the damage done is proportional to the density of infection.

BOTRYTIS SP.

Stahel describes a species of Botrytis as constantly found with *Melanopsammopsis Ulei* in Dutch Guiana. The fungus is not evident on Trinidad material examined by me.

DEW.

Stahel declares the disease to be worse in dry weather and attributes this to a heavier deposition of dew during fine nights enabling the spores to germinate better. The original observation is not borne out by writers or planters in British Guiana.

SOILS.

Appear to have no influence on the incidence of the disease. The comparative freedom of Coast rubber is most likely due to drier atmospheric conditions.

GENERAL.

The history of the South American leaf disease, like that of the chestnut disease of the United States, should serve as a warning to those who adopt the facile view that a knowledge of the life history of a disease is the same thing as a knowledge of practical methods of control. As it happens the failure of the rubber plantations of Guiana affects comparatively few, as the total planted area is

small but it does not require much imagination to picture the effect of this or any other leaf disease rampant on the massed plantations of the Federated Malay States.

A good deal was written a few years ago about the necessity for a fresh importation of stock from Brazil, which was partially or entirely to replace our effete rubber and to be immune to many of our diseases. It cannot be too strongly urged that such importation if carried out should be under the strictest scientific control; although the likelihood of the importation and establishment of the South American leaf disease appears to be small, practically nothing is known of the diseases of rubber in Brazil and there is a serious risk of introducing some leaf (or other) disease comparatively harmless on the scattered trees of the jungle, which might spread to an alarming extent on our plantations.

—*Agricultural Bulletin, Federated Malay States.*

THE COMMERCIAL SIDE OF FARMING.

Everyone interested in the welfare of rural industry, and therefore who thinks nationally, knows that the unsatisfactory conditions with which agriculture is burdened to-day are due in a very large measure to lack of effective co-operation. Agriculture is not merely farming; it is a business, an industry, and on its commercial side it has two important aspects. From a national point of view it is desirable that food should be produced at the most reasonable price to the consumer compatible with a fair profit to the producer. From the farmer's point of view it is essential that he should be able to market successfully that which he produces not only in lean seasons when supply is less than the demand, but also in seasons of plenty when conditions are reversed. He should always be stimulating demand, and the best stimulus is reasonable prices. To sell at reasonable rates it is important that produce should reach the consumer loaded only with the lowest possible intermediate charges. The cost of pro-

duction and distribution must be reduced to a minimum. In turn the cost of purchasing machinery, fertilisers, and other equipment and commodities necessary for the carrying on of the farmer's business should also be reduced to a minimum. And to ensure this reduction both ways, agricultural co-operation is the only effective means. The advantages that lie in the bargaining power of combination are obvious. By combination in both buying and selling the farmer would receive: (1) the benefit of wholesale rates, and (2) reduction of intermediate costs of distribution. The days of single purpose co-operation are passing. What is seriously engaging the thought of those concerned most closely with rural economics is not only the co-operation of individual farmers but also the effective co-operation of co-operative concerns. The whole strength of the co-operative movement depends upon the reality, the extent, and continuity of combined action. In no other way can farmers secure the best terms on both the buying and selling sides of their business. By no other road can they reach a position of commercial strength which will enable them to meet the biggest buyers of their produce on level ground. An unalterable condition of the acquisition and retention of that power is their absolute loyalty to their own business ventures. The weakness of co operative concerns to-day is that farmers are often not loyal to the enterprises they themselves have created. Not that they, less than any other section of the community, are wanting in the moral quality of loyalty, but, for some reason or other, they apparently cannot see how much it is to their advantage to maintain effective and continuous combination for the sake of the commercial power it would confer upon them. If farmers get together, stick together, and act together in all things for the betterment of their industry, it will not be long before they will be in a position to effectively control their business on both sides from the bucket to the selling floor, from the paddock to the pantry, and reap rewards for their labour that would be reasonable and just.

—*Queensland Agricultural Journal.*

GRAPE CULTURE.

By Fitz Greeves,

Senior Agricultural Instructor.

Grape Vines require as much sunshine as can possibly be obtained and should never be planted where the root condition can be shaded. They should be planted as far as possible from large growing trees. Sunlight and plenty of air are indispensable and should be secured.

SOIL.

Any good garden soil with good drainage will do fairly well, and where such is not the case, it should be provided. Good drainage means good ventilation of the soil, and that means that all the processes essential to fertility are at work.

Before the vine is planted the soil should be well broken up to the depth of $1\frac{1}{2}$ to 2 feet. The deeper and broader the tillage, the larger will be the root run, the ampler will be the food supply and the more vigorous the vine. Some well rotted stable manure, wood ashes, broken bones and lime-rubbish added at the time the ground is prepared will be of lasting service. The less the soil is disturbed afterwards, the better. Where stable manure is used constantly, a light dressing of lime every three or four years will be of benefit. Badly nurtured vines are exposed to numberless perils from both insect pests and diseases, which healthy vines escape.

PROPAGATION.

Vines may be propagated from seeds, but the general method is to grow them from cuttings which will come into bearing earlier.

So soon as root action begins and new growth shows, a slender twiggy stick about 5 or 6 ft. long should be given it to climb up, as without this aid the vine will show possibly two or three growths not one of them of any value. No sub-laterals must be allowed to grow; they must be stopped at the first leaf, but on no account must they be taken out

entirely; their province is to feed and develop the main growth, and if they are removed the cane will probably ripen when a little thicker than an ordinary pencil. Vines may be trained in a variety of ways, each having its own advantage. Thousands of vines, we are told, and tons of grapes are grown annually in pots, where land cannot be obtained for a permanent trellis, this method might often be usefully adopted. Trellises may be made at the discretion of the grower and adapted to circumstances. Whatever method of training may be followed, the principles that govern the training, pruning and after-treatment are the same.

Fruit may be taken from a vine the second year; it is however better not to do so, but wait one or even two years longer, by which time the vine should be strong and vigorous to yield fruit for many years.

PRUNING.

This is an intentional and artificial removal of certain portions of the vine to serve one or more of the following ends:—

(1) To give some desired shape to the vine.
(2) To remove superfluous or ill-shaped growths.
(3) To concentrate the vital forces of the vine within a limited area.
(4). To secure an even distribution of fruit over the different parts of the vine.
(5) To open up and keep the canes (stems) with foliage and fruit well exposed to the influences of air, light and warmth, and to secure more and better fruit. You may put a new reading into the old proverb—"Spare the knife and spoil the vine" for "a vine left to itself bringeth its owner to shame."

Young vines pruned to one eye do well, but old vines must be pruned back to a good plump visible bud. Vines should be pruned at the same time every year, not until the canes or stems are ripe, and then pruned back to two or three eyes. In pruning, first cut out all dead or dying wood, then take out all the thin feeble immature

growths that are perpetually showing on the trunk and branches of old vines. You ought then to have nothing left except the ripe canes from which you are to get your crop. Apply the same principle to all the canes alike. Cut out completely all sub-laterals. Leave nothing on the vine but what has a purpose to serve by being there. After pruning your vine must be well watered until new growth begins, after which the vines must not be allowed to need much water. Never start a vine into growth with dry roots; as soon as the new growths show where the fruits will be, attention must be given to restricting the crop. Never leave more than two bunches on one cane as nothing is lost by doing this

After the fruits have set, no time should be lost in thinning.

When quality is required it is safe to cut out from one-third to one-half of the berries—some growers take out as many as two-thirds. At the time of thinning, shoulders should be tied up carefully or else cut out—never allow them to press upon the bunch.

rapes that ripen in the shade are of a superior flavour take a better colour, and keep better.

The following are the varieties which thrive and fruit best in this Colony:—

Royal Ascot, a small, dark, purple variety, which sometimes fruits without being pruned and is not sweet until very ripe.

Black Hamburg, a dark purple berry, somewhat larger than the preceding one, of a much nicer flavour.

Muscat of Alexandria, a pale green variety when ripe, round berry, large bunches and of a delicious flavour.

White Muscatel, a whitish, large, oblong berry, large bunches and a fine flavour.

DISEASES.

Shanking—caused from over-cropping, too early ripening of wood, excessive heat and moisture. The causes always arise from soil condition, and defective nutrition. In this case, the berries at the end of the bunch wither and show signs of falling off.

Authracuose or coal disease.—This fungus attacks all parts of the vine, but most commonly the berries. The disease is so called from the dark colouration of the affected parts. Spraying with Bordeaux Mixture is recommended as a cure.

Vine Mildew.—This disease attacks the skin of the fruit and causes it to burst. Dusting the fruit with "Flowers of Sulphur" destroys the fungus.

PLANTS WORTH KNOWING.

By John F. Waby.

Brexia madagascariensis. Its specific name denotes its country of origin. I first met this plant in 1869, in the "Jardim Fleuriste de la Muett" Passy, Paris, where I had obtained a position as Eleve, and where I stayed for two years before the Franco-Prussian War. I did not meet it again till I grew and planted it in the borders of the Botanic Gardens, British Guiana, where there are 3 plants. It is practically scarce. It is a straightish growing hard-woody tree with short brittle branches. Foliage of a dark opaque green on the upper side and perceptibly paler beneath, set closely together on every side, petiole fairly stout, $\frac{1}{2}$ inch long, the blade 4-5 inches long, $1\frac{5}{8}$-$1\frac{3}{4}$ inches wide, narrowing towards the petiole, rounded at point, midrib quite plain, more especially beneath, cross veins scarcely perceptible. Inflorescence in terminal cymes on twiggy branches, spreading 2 inches across, peduncle $1\frac{3}{4}$ inches long, flat, $\frac{1}{8}$ inch wide, green. Pedicils $\frac{1}{2}$ inch long, not very stout, green, individual flowers pale creamy green of 5 oblong petals, $1\frac{1}{8}$ inches across the top of the flower, 5 rather stout stamens at base and in between the petals, $\frac{1}{2}$ inch long with anthers attached at top, pale creamy green; pistil in centre with pyramidal base $\frac{3}{16}$ inch across narrowing to apex and the rounded stigma, all green. A dark green flat calyx of 5 sepals attached beneath. The fruit, rarely produced, is a dry, woody, indehiscent capsule, $2\frac{1}{4}$ inches long, 1-$1\frac{1}{4}$ inches wide, sharply pointed, with 5 sharp ridges from base to apex, ridges corresponding inside as divisions, the whole interior pale yellow, with small brown seeds similar to radish seed though no tround.

Uroskinnera spectabilis, from Guatemala. A spreading shrub $2\frac{1}{2}$—3 feet high. Foliage set $1\frac{1}{4}$ inches apart, in pairs alternate; petiole $1\frac{1}{2}$ inches long, stout, the blade 4 inches long, $3\frac{1}{2}$ inches wide, serrate, midrib and veins

dark coloured, the latter very regular $\frac{1}{4}$ inch apart, prominent beneath, these and the general colour very pale creamy green, pubescent both sides. Inflorescence terminal, racemose, pyramidal, $2\frac{1}{2}$-$3\frac{1}{2}$ inches long, individual flowers set very close together $1\frac{1}{2}$ inches long, tubular, $\frac{3}{4}$ inch wide at top narrowing to $\frac{1}{8}$ inch to the calyx, mouth divided into 5 segments, back of tube almost white, the remainder mauve coloured. A tiny calyx, green, of 5 filiform sepals. Fruit a small capsule $\frac{1}{4}$ inch long, $\frac{3}{16}$ inch wide. Seeds tiny, black. The young growth is all soft, flannelly, pale green; the old shoots dark coloured, hard-woody.

Odontadenia speciosa, the "Iam flower," so called because of its perfume, native of Guiana. A strong growing climber covering the largest trees at the same time, it is like a good many strong climbers amenable to curtailment on an arched trellis. Foliage in pairs 3-6 inches apart. Individual leaves ordinary dark green, 7 inches by $3\frac{1}{2}$ inches to 12 inches by 6 inches acuminate, waved, entire; midrib and cross-veins quite plain, the latter set about $\frac{1}{2}$ to $\frac{3}{4}$ inch apart, petiole one inch long. Inflorescence a terminal panicle, 9 inches or more long spreading over 12 inches. Individual flowers orange coloured, tubular, streaked in centre with reddish streaks; peduncle one inch long, fairly stout, tube 2 inches long, $\frac{3}{4}$ inch diameter, sloping down to ovary fitting into the calyx of 5 pointed sepals. Spread of corolla $3\frac{1}{2}$ inches of 5 fringed petals of substantial crêpe, joined to summit of tube. Outside of corolla plain yellow edges, petals tinged with pink. Inside tube 5 ridges, streaked with red. Fruit 9 inches long, 3 inches wide at widest part, pointed; when dry dehiscing down the middle of the back; case comes off clean, leaving the seeds closely packed on a brown replum, these a dull black about 2 inches long, solid, like closely channelled caterpillars with a silky white coma at the upper end $1\frac{1}{2}$ inches long, opening out like the pappus of a compositae.

Putranjiva Roxburga, from India and Burmah. A tall growing shapely tree with straightish branches and short twiggy branchlets. Foliage of various sizes up to

$4\frac{1}{4}$ inches long and $1\frac{1}{2}$ inches wide, serrated, waved, pointed, dark green, midrib alone plain, petiole $\frac{1}{4}$ inch long, set 1 inch apart, alternate. Inflorescence axillary in tiny green fascicles; flowers very small. Fruit at first quite glaucous green, solitary or 2 or 3 together, peduncle $\frac{1}{2}$-$\frac{3}{4}$ inch long, small brown calyx of 5 sepals, elliptical $\frac{3}{4}$ inch long, $\frac{1}{2}$ inch diameter, small divided stigma at point. The ripened fruit, a one-seeded drupe, elliptical, 1 inch long, $\frac{7}{8}$ inch wide, cream coloured; seed hard $\frac{3}{4}$ inch long, $\frac{7}{16}$ inch diameter, pointed both ends, the difference between seed and ripe fruit filled in with a bitter soft substance.

Allamanda nereifolia, of South America. A shrub $2\frac{1}{2}$ to 3 feet high, not climbing. Foliage in whorls of 5 leaves almost sessile, set at 2-3 inches apart, 4 inches long, $1\frac{1}{2}$ inches wide, entire, acuminate, dark green, above, paler beneath; midrib prominent, cross veins set fairly close together, meeting an extra vein on the side of the leaf. Stems green, fairly stout. Inflorescence terminal of few flowers. Individual flowers 2 inches long, tubular, narrowing at base into a green calyx of 5 small green sepals, pointed; narrow portion of tube $\frac{3}{4}$ inch wide, upper portion 1 inch wide, $1\frac{5}{8}$ inches across top of corolla of 5 petals, tube $\frac{5}{8}$ inch across, deep golden yellow, tube streaked with close purplish lines. Fruit an echinate capsule, $1\frac{1}{2}$ inches across, including the spines $\frac{3}{8}$ inch long, dehiscing in 2 valves. Seeds thin, $\frac{7}{8}$ by $\frac{5}{8}$ inch, brown, unwinged, dry.

Allamanda Schottii, from Brazil. This is a strong growing climber, though not a close one. Foliage in whorls of 4 leaves, set 2-3 inches apart, almost sessile, 4-$4\frac{1}{2}$ inches long, $1\frac{1}{2}$-2 inches wide, acuminate, entire dark shiny green above, paler beneath, midrib prominent, cross-veins regular $\frac{1}{4}$-$\frac{1}{2}$ inch apart. Stems green, tinged with purplish pink. Inflorescence terminal, few flowered. Individual flowers $5\frac{1}{2}$-6 inches across of 5 petals golden yellow, tubular. Tube $1\frac{1}{4}$-$1\frac{1}{2}$ inches diameter, $1\frac{1}{2}$ inches deep with reddish streaks, narrow base of tube 2 inches long, fitting into a green calyx of 5 pointed sepals $\frac{7}{8}$ inch

long. Peduncle stout, $\frac{1}{4}$-$\frac{1}{2}$ inch long. Fruit a dry echinate capsule, including the spines 3 inches across, spines $\frac{7}{8}$ inch long, dehiscing in 2 valves. Seeds flat, brown, rim-winged, button-like, an inch across.

SITUATION WANTED.

MEETING OF THE BOARD OF AGRICULTURE.

A meeting of the Board of Agriculture was held at the offices of the Department of Science and Agriculture, Broad Street, on Thursday, June the 29th, 1922. His Excellency the Governor, Sir Wilfred Collet, K.C.M.G., presided; also present were Messrs. W. Francis, acting Director of Science and Agriculture and acting Chairman of the Board, the Hon. G. D. Bayley, Messrs. A. Seton Milne, S. H. Bayley, Edgar Beckett, R. Ward, J. Crabtree, T. Earle, the Rev. E. R. O. Robertson and Miss Van Nooten, acting Secretary.

The acting Chairman reported that Sir John Harrison had applied for and secured six months' leave of absence. He had also applied for an extension which would carry his leave to the end of October.

Geological Conference.

His Excellency remarked that there would be a Geological Conference at Brussels. The Government had received a telegram inquiring whether it would be practicable for Sir John Harrison to attend. He felt that the Conference might be of some help to the diamond industry.

The Board approved of the leave of absence for six months granted to Mr. A. E. Bratt, also to leave granted to Messrs. W. M. B. Shields, H. L. Humphrys, B. Gainfort and M. P. Camacho, also of the appointment of Mr. C. L. C. Bourne as editor of the Journal of the Board of Agriculture and of that of Mr. W. Mearns and Captain D. H. Rylands as co-optative members of the Live Stock Committee.

Copies of the "Journal" of the Board were laid over for the information of members, also a report of the revised price list for padi, the list of Registered Veterinary Surgeons in the colony, and members of the Board and its Committees.

Examining Cattle.

Mr. Robertson raised the question of cattle imported into the colony being examined before they were landed. In the outlying districts such examination might be done by deputies.

Mr. Seton Milne remarked that there were some so-called Veterinary Surgeons in the colony who were registered. Recently a case of tetanus came under his notice and a Veterinary Surgeon was treating it for impaction of the bowels. If there was an outbreak of foot and mouth disease as in England those men who had never seen the disease would cause it to spread over the country. The death-rate would be appalling and they probably would not save a single animal.

Mr. Robertson said his object was to get the animals examined before they were landed.

His Excellency inquired what the custom was in Surinam.

Mr. Seton Milne replied that all animals which arrived were examined before they were landed. With regard to the shipload which arrived in Surinam, the disease was discovered after the animals had been landed. In the case of the nineteen head which were landed in this colony, he examined them as a private practitioner. Mr. McLean paid him $10 for the examination.

His Excellency remarked that his impression wasthat all cattle imported into the colony should be be slaughtered immediately upon arrival unless they were imported with special Government permission.

Mr. Robertson moved the following resolution, which was seconded by Mr. Beckett:—

"Whereas there has been an outbreak of dangerous disease in countries from which animals are imported into this country;

"And whereas there is no provision for the inspection of animal before landing in the colony, this Board respectfully requests His Excellency the Governor to appoint the Government Veterinary Surgeon an Inspector of Animals

imported before landing in the colony, and that the Government Veterinary Surgeon be empowered to levy a fee."

It was decided that as the Board had the power to order an inspection, a resolution was not necessary.

It was further agreed to amend a previous order prohibiting importation from Venezuela, Brazil, Trinidad etc., in order to permit of the inclusion of Great Britain Ireland and the United States.

AGRICULTURAL CENSUS.

The Board then considered the report on the results of the Agricultural Census for 1920 and 1921 which is as follows:

RESULTS OF THE AGRICULTURAL CENSUS FOR 1920 AND 1921.

Crops of	*1920*	*1921*
Sugar Cane	69,532	63,420
Rice, Total acreage	54,438	55,911
,, Spring Crop	14,023	23,522
,, Autumn Crop	51,718	40,560
,, Total acreage reaped	65,741	64,082
Coconuts	24,425	26,321
Cacao	1,846	1,176
Coffee	5,051	5,030
Rubber	2,813	2,813
Limes	1,054	1,102
Ground Provisions	15,686	15,297
Maize	1,147	1,081
Live Stock.		
Horses, Coastlands	941	1,097
,, Hinterlands	300	665
Mules	2,105	*2,202
Donkeys	7,106	†6,581
Cattle, Coastlands	85,938	83,906
,, Hinterlands	26,000	38,980

*Including 20 Mules in the Hinterlands.
†Including 12 Donkeys in the Hinterland.

Cattle Total	111,938	122,886
Buffaloes	174	212
Goats	11,250	11,642
Sheep	22,202	*20,602
Swine	17,401	†12,312

CROPS.

Administrative District and nature of crop.	Number of acres under cultivation.	Gross quantity of produce for local consumption and export.
Berbice.		
Sugar	19,210	36,522 tons
Molasses	...	48,600 glns.
Cattle Food	...	444 tons
Rum (Proof)	...	534,516 glns.
Rice	23,283	298,801 bags padi
Coconuts	7,002	3,461,443 nuts
Coconut oil	...	28,388 glns.
Copra	...	...
Cacao	49	6,011 cwts.
Coffee	18	15 cwts.
Rubber	545	...
Limes	401	...
Lime Juice, raw	...	3,860 glns.
,, ,, concentrated	...	3,224 glns.
Citrate of Lime	...	(313 cwt) 35,047 lbs.
Oil of Limes	...	3,759 glns.
Ground Provisions	‡6,112	‖...
Demerara		
Sugar	40,378	65,701 tons
Molasses	...	1,230,834 glns.
Cattle Food	...	728 tons.
Rum (Proof)	...	1,062,147 glns.
Rice	26,097	374,060 bags padi
Coconuts	12,288	7,251,208 nuts
Coconut oil	...	17,035 glns.
Copra	...	3,000 lbs.

*Including 206 Sheep in the Hinterland.
† ,, 77 Swine ,, ,,
‡Including 1,324 acres under cassava and 246 under corn.
‖Starch 5,307 cwts.

Cacao	885	587 cwts.
Coffee	2,455	2,365 cwts
Rubber	1,196	1,640 lbs.
Limes	210	...
Ground Provisions	*5,791	...
Essequibo		
Sugar	3,832	8,762 tons.
Molasses	...	513,976 glns.
Rum (Proof)	...	209,988 glns.
Rice	6,531	125,621 bags padi
Coconuts	7,031	4,935,995 nuts
Coconut oil	...	3,101 glns.
Cacao	242	237 cwts.
Coffee	2,557	5,122 cwts.
Rubber	1,072	1,546 lbs.
Limes	491	...
Lime Juice, raw	...	10 glns.
,, ,, concentrated	...	950 glns.
Citrate of Lime	...	161 cwts.
Oil of Limes	...	776 glns.
Ground Provisions	§4,474	...

PASTURE.

Acreage of pasture land by district.

Class of savannah and District	Area Acres.
Coastal or wet Savannahs flooded in wet seasons Counties of Demerara, Essequibo and Berbice	768,000
Intermediate savannahs elevated 150 to 300 feet.—Counties of Demerara and Berbice	1,280,000

LIVESTOCK.

Administrative District and nature of livestock	Number
Berbice—	
Horses	280
Asses	3,274
Mules	500
Horned cattle ...	43,467
Sheep	13,682
Goats	5,754
Buffaloes	27
Swine	6,097
Demerara—	
Horses	745
Asses	2,492
Mules	1,443
Horned cattle ...	31,940
Sheep	5,254

*Including 463 acres under cassava and 90 under corn.
§Including 789 under cassava and 745 under corn.

Interior savannahs, elevated 400 to 3,000 feet—	
Rupununi and Western Essequibo Districts	3,968,000
Total savannah area (Approximately)	6,016,000

Goats	3,800
Buffaloes	91
Swine	4,429
Essequibo—	
Horses	72
Asses	803
Mules	239
Horned cattle ...	8,499
Sheep	1,460
Goats	2,088
Buffaloes	94
Swine	1,709
Hinterland—	
Horses	665
Mules	20
Donkeys	12
Cattle	38,980
Sheep	206
Swine	77

IMPERIAL FRUIT SHOW.

The question of the participation of the West Indian Colonies in the Imperial Fruit Show, 1922, was then considered.

His Excellency raised the question of mango growing. He said very good mangoes could be grown in the Colony but what were they going to do with them. He did not think they ever sent mangoes into cold storage and had never seen mangoes in London. He was inclined to think, however, that something might be done with a little co-operation by preserving the mangoes. His Excellency also thought that if the people organised they could sell coconuts profitably.

Samples of seed padi from India and Ceylon were then exhibited.

Mr. Robertson inquired the reason for red rice on the market.

Mr. Peterkin explained that red rice was due to faulty selection of padi.

The Board did not consider it necessary to legislate to prevent the poisoning of water holes and the burning of pastures in savannahs and other lands.

An application by ex-agricultural apprentice R. T. Gibson for] a diploma of competency was deferred until the return of Sir John Harrison.

A report on the outbreak of disease in Paramaribo among animals received from Brazil was taken for notification.

It was reported that a Shorthorn Bull and heifer had been imported from the U.S.A. at a cost of $1,055.77.

A report of the Committee appointed by His Excellency the Governor to consider the question of the cost of maintenance of Police horses and suggestions in connection with the stallion horse and donkey was taken for notification.

The Board approved of the suggested transfer of unserviceable mares of the Police Force to the Board for breeding purposes.

It was reported that the net proceeds of Live Stock sale on the 19th inst. amounted to $842.74.

A suggestion by Mr. Milne to exchange the stallion "Water Bass" for the stallion in Trinidad was referred to the Live Stock Committee.

A proposal to import Indian game poultry was also referred to the Live Stock Committee.

Providing Work.

Mr. Robertson then moved: That in view of the widespread economic distress felt by all classes throughout the Colony with the consequent unemployment and the bitter cry of all sections of the community for irrigation and drainage schemes to alleviate distress and unemployment, this Board earnestly appeal to His Excellency the Governor to approach the Combined Court for power to borrow one million pounds to be allocated for assisting such schemes as shall receive the approval of the Governor-in-Council."

After some discussion the motion fell through for want of a seconder.

EXPERIMENTAL STATIONS.

Mr. Robertson then moved : "Resolved,—That this Board, convinced of the utter uselessness of giving practical instruction in agriculture to farmers without the help of experimental stations appoint a Committee to go into the question with a view to their early re-establishment."

He had never known of any country which taught the people the elements of agriculture without experimental stations.

The motion also fell through, not having been seconded.

His Excellency asked whether he thought that the Agricultural Instructors were absolutely useless.

Mr. Robertson replied that they might not be utterly useless but money was being spent on a department which was lagging behind so far as teaching the people agriculture was concerned.

His Excellency stated that if they were useless he would get rid of them. He had no money to go in for experimental stations.

On the motion of Mr. Robertson the Board decided to recommend that the services of Mr. H. B. France, Agricultural Assistant be utilised entirely by the Board.

Mr. Robertson agreed that the following motions in his name should be postponed until the return of Professor Sir John Harrison.

"That this Board appoint a Committee to consider the whole question of the teaching of agriculture in the primary schools of the colony with a view to bringing the instruction in agriculture more directly under the Board."

" That this Board, after four years' trial, is satisfied that the scheme for placing District Agricultural Instructors in the several farming centres of the colony, has been a success and recommend to the Combined Court through the Government the addition of three or four more instructors to the present staff."

Cotton Growing.

Mr. Robertson mentioned that he had heard that an English firm was willing to finance cotton growing in the colony.

His Excellency said he did not think cotton growing would ever be made to pay. It could only be done by peasant farming and the only favourable place was Morawhanna.

Some further discussion ensued with regard to the question of irrigation, after which the meeting terminated.

Meteorological Data—April to June, 1922.

Months	Rain-fall.	NUMBER OF DAYS OF RAIN						Evapo-ration.	Air Temperature and Humidity.			
									Air Temp.			
Botanic Gardens.	Total Inches.	Under ·10 Inches.	·10 to ·50 Inch	·50 to 1.00 Inch	1.00 to 2.00 Inches	Above 2.00 Inches	Total days.	Inches	Maximum.	Minimum.	Mean	Humidity. Mean
April ...	.60	6	1	...	...	...	7	6.38	85.0	75.8	80.4	74.8
May ...	11.20	7	11	6	1	1	26	3.96	84.2	75.7	79.9	81.8
June ...	14.58	8	9	6	3	1	27	3.76	84.2	75.2	79.7	82·2
Totals & Means.	26.38	21	21	12	4	2	60	14.10	84.5	75.6	80.0	79.6
Berbice Gardens												
April ...	2.42	3	4	2	...	...	9	...	85.6	74.9	80.2	72.0
May ...	11.03	5	10	4	4	...	23	...	84.9	74.5	79.7	79.1
June ...	18.43	2	8	8	2	3	23	...	85.7	74.0	79.8	83.2
Totals & Means.	31.88	10	22	14	6	3	55	...	85.4	74.5	79.9	78.1
Onder-neeming.												
April ...	1.48	3	3	1	...	...	7	...	88.5	73.0	80.7	...
May ...	15.02	1	12	9	3	1	26	...	85.9	71.7	78.8	...
June ...	18.41	...	9	6	7	1	23	...	86.0	71.8	78.9	...
Totals & Means.	34.91	4	24	16	10	2	56	...	86.8	72.2	79.5	
Mora-whanna												
April ...	3.07	3	6	2	...	...	11	...	...	...	...	...
May ...	26.77	4	9	7	7	3	30	...	...	...	...	...
June ...		Not	yet	ava	ilabl	e		...	...	...	...	...
Totals ...								...	...	...	...	...

ATTENDANCES AT THE DISTRICT GARDENS.

Year.	Bourda.	Belfield, E. Coast.	Stanleytown, New Amsterdam.	Suddie, Essequibo.	Den Amstel.	Houston, E. Bank.	Wakenaam.	Total Attendances.
1912 ...	5,514	4,395	3,302	2,100	2,544	2,156	1,718	21,729
1913 ...	5,156	4,535	2,519	3,399	2,568	1,836	1,319	21,332
1914 ...	4,243	3,869	2,443	3,025	1,791	1,653	1,533	18,577
1915 ...	1,123	1,006	769	59	503	339	401	4,209
1916 ...	4,705	1,161	1,510	225	623	2,251	1,297	12,026
1917 ...	4,991	2,820	1,366	3,297	1,186	2,564	1,663	17,086
1918 ...	4,834	3,081	1,653	2,671	2,162	2,790	2,067	19,258
1919 ...	4,769	2,425	1,582	2,798	1,851	2,480	1,556	17,461
1920 ...	6,285	2,312	1,665	2,525	2,532	3,228	2,148	20,695
1921 ...	5,671	1,968	1,642	2,629	1,949	2,539	1,610	18,008
1922 ...								
1st Quarter	1,010	532	435	637	510	490	350	3,964
2nd Quarter	708	306	365	317	355	274	261	2,587

EXPORTS OF AGRICULTURAL AND FOREST PRODUCTS.

Below will be found a list of the Agricultural and Forest Products of the Colony exported during the first six months of 1922. The corresponding figures for the two previous years and the average for the four years previous to that are added for the convenience of comparison.

Product.	*Average 1916-19.*	*1920.*	*1921.*	*1922.*
Sugar, tons ...	40,556	36,329	34,251	43,926
Rum, gallons ..	2,199,613	1,011,761	1,582,575	311,248
Molasses, gallons ...	50,000	None	None	27,405
Cattle-food (Molascuit tons)	872	552	1,055	284
Cacao, cwts. ...	20	8	None	None
Citrate of Lime, cwts.	120	229	34	54
Lime Juice, gals. ...	5,633	None	441	3,594
Essential Oil of Limes, gals. ...	135	None	108	*
Coconuts, thousands	1,242	2,218	1,458	889
Coconut Oil, gals. ...	12,716	6,985	7,705	16,848
Copra, cwts. ..	993	296	599	559
Coffee, cwts. ...	3,191	2,989	390	5,189
Kola-nuts, cwts. ...	2	10	None	None
Rice, tons ...	6,531	8,036	4	5,456
Ricemeal, tons ...	35	None	None	None
Cattle, head ...	275	None	None	103
Hides, No. ...	2,197	3,405	1,832	2,999
Pigs, No. ...	267	None	None	5
Sheep, head ...	10	136	None	32
Balata, cwts. ...	3,302	2,167	3,469	1,976
Charcoal, bags ...	22,834	24,785	23,268	26,361
Firewood, Wallaba, etc., tons ...	4,807	2,708	3,502	3,865
Gums, lbs. ...	327	3,361	7,913	None
Lumber, cub. ft. ...	101,547	130,330	44,365	70,281
Railway sleepers, No.	6,436	4,707	3,114	13,846
Rubber, cwts. ...	42	118	6	None
Shingles, thousands	1,236	883	1,012	1,100
Timber, cub. ft. ...	70,915	29,587	83,097	47,320

* No records available.

Errata: Vol. XV., No. 2, Exports of Agricultural and Forest Products, *read* Rice, tons for 1922, 294 tons instead of 65,882.

JOURNAL
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BRITISH GUIANA.

VOL. XV. COTOBER, 1922. No. 4.

EDITORIAL NOTES.

IN our last issue we deplored the absence of entomological material and expressed the hope that articles of this nature would continue to be a feature of the Journal. This wish has been gratified and we are glad to recommend our readers, especially the sugar planters and farmers of this colony, to carefully peruse the "Notes on Small Moth Borers of Sugar Cane, by Mr. L. D. Cleare, who has succeeded Mr. G. E. Bodkin as Government Economic Biologist. We suggest that this article be read in conjunction with another by Mr. Cleare, which appeared in Vol XIII. No. 3 of this Journal. The latter forces us to the realization of the great annual loss which this Colony suffers through insects. The damage produced by small moth borers all over the Colony is not inconsiderable and every effort should be made by the sugar planters to suppress these pests, and by co-operation, to reduce the losses due to them to a minimum. Finally, the suggestion which has been put forward that fields be replanted every four or five years appears to be quite practicable and is worthy of consideration, and we are further of opinion that on those estates where the labour supply is adequate, other control measures should be carried out along the lines recommended by the Government Economic Biologist.

The article by Mr. Maurice Bird which we have culled from the International Sugar Journal gives some interesting facts about our soils which point to the necessity for careful analyses being made from time to time in order that the planter might know exactly what manures are required instead of applying these in a haphazard manner, which is so often likely to be unprofitable.

In his notes on Anthrax, the Government Veterinary Surgeon once again warns the owners of cattle to have their animals vaccinated every year. Considering the very low cost to them of this preventative measure, and the large annual loss which they suffer in consequence of this disease, it is remarkable the amount of indifference displayed by some cattle owners by neglecting and even refusing to have their animals vaccinated.

An interesting paper is that on the Poultry Industry. In addition to giving useful hints on breeding, it serves to illustrate how those in a neighbouring colony are striving to keep awake an interest in this minor industry.

"Rice," by Mr. Edgar Beckett, is an article which makes profitable reading. The rice farmer would do well to take the advice given therein. The Board of Agriculture has done its utmost to foster this industry by supplying selected seed, but it rests with the farmer to see that the quality of the rice in his cultivation is maintained by proper selection of seed paddy.

NOTES ON SMALL MOTH-BORERS OF SUGAR-CANE IN BRITISH GUIANA.

By L. D. CLEARE, JNR., F.E.S.,
Government Economic Biologist, British Guiana.

Sugar-cane is the principal crop of British Guiana and during the year 1921 there were 65,870 acres under cultivation in this crop. This area yielded 110,985 tons of sugar and 2,228,164 gallons of rum, the value of the crop being about $10,355,000 (£2,157,200).

With the exception perhaps of the Giant Moth Borer, *Castnia licus* Drury, which caused very serious losses about twelve years ago, and which at that time threatened the industry in this colony, there are to-day no insects of such importance to the inhabitants of British Guiana as the Small Moth Borers of the sugar-cane.

As far back as 1879 small moth-borers appear to have been serious pests of sugar-cane in British Guiana, indeed records show that in that year there was a meeting of the leading sugar planters of the Colony to discuss the seriousness of the situation and to enquire into what methods of destruction should be carried out against these insects.

In the same year Miss Ormerod, as the results of correspondence with certain estate proprietors of the colony, published a paper in Proc. Ent. Soc., London, entitled "Sugar-cane Borers in British Guiana." This may be taken as the first scientific contribution on these insects from British Guiana.

The seriousness of the situation was apparently not fully realised, for little appears to have been done at that time in controlling the insects, indeed it can be said that it is only very recently that it has come to be generally recognised.

In 1911 there was a very serious outbreak of the Giant Moth-Borer in the colony and Mr. J. J. Quelch was engaged by Messrs. Booker Bros. and Curtis Campbell and Co., to investigate that insect and recommend measures for its control. This task Mr. Quelch very effectively accomplished, but while enquiring into that insect he was

able to recognise the terrible damage wrought by the small moth-borers, and immediately began the study of these insects.

About 1913 Mr. Quelch gave up his researches which were then taken up by Mr. H. W. B. Moore. Mr. Moore is still engaged on some sugar estates to advise on methods of control and to superintend such work. Both of these gentlemen have contributed many reports on small moth-borers and other insect pests of the sugar-cane in British Guiana.

Between 1911 and the present time Mr. G. E. Bodkin, until recently Government Economic Biologist of this colony, has contributed to the literature of these and other sugar-cane pests principally in the Reports of the Biological Division of the Department of Science and Agriculture.

Species of Diatraea Concerned.

There are two species of small moth-borers that are particularly injurious to sugar-cane in British Guiana, while a third is sometimes found attacking it. The first two species are *Diatraea saccharalis* F. and *Diatraea canella* Hmpsn., while the third species is *Diatraea lineolata* Dyar.

Summary of Life Cycle.

In general the life cycles of the different species are similar: the egg period is about six days, the larval period varies from three weeks to a month or more, and the pupal period lasts about a week. There are, however, distinguishing characters for the various stages of the different species.

The Eggs are oval and flattened and are deposited in clusters, and, beginning from the top of the cluster they partly overlap one another after the manner of the scales of a fish. The number of eggs in a cluster varies considerably, from 2 or 3 eggs to as many as 100 or more, the number usually being between 20 and 40 eggs.

The eggs of *saccharalis* are individually smaller than those of *canella* and are generally laid in clusters of about

five rows, while the eggs of the latter species are generally laid in clusters of two or three rows and bear certain red markings which are characteristic. When freshly laid the eggs of both species are of a yellowish-white colour. After the emergence of the larvae the empty shells become translucent white and their appearance has been well likened to a fragment of cast snakeskin.

The eggs are generally deposited on either side of the green blades, but may also be found on the dry trash attached to the cane or on the trash on the ground, and even on blades of grass and other weeds not their food-plants.

Parasitized clusters become jet black after a few days and retain this colour even after the emergence of the parasites; on account of their colour they are easily seen in the field. Clusters from which parasites have emerged are readily discernible by the holes made in them by the parasites in the act of emerging.

The larvae. It is this stage of the insect that commits the destruction by boring into the cane and it is with it that the sugar planter is chiefly concerned.

When fully grown the larvae measure about 1 inch long by one-eighth inch wide, and the different species are readily distinguished. In *saccharalis* the head of the larva is a very dark brown, almost black, colour, while the larva of *canella* has a bright yellow head and a black or yellow triangular mark on the second body segment; they may thus be known as the "black-headed borer" and the "yellow-headed borer" respectively.

Even the freshly emerged larvae show distinct differences for while those of *saccharalis* are more or less of the same colour as the fully grown larvae, the freshly emerged *canella* larvae appear to be bright red in colour, broken here and there by light bands, the head being yellowish-brown. The freshly emerged *canella* larvae are also considerably larger than *saccharalis* larvae of the same age.

The moths too are easily distinguished, *Diatraea saccharalis* being distinctly straw-coloured, while *Diatraea canella* is of a dark grey colour and usually larger.

Diatraea lineolata Dyar, is only occasionally found feeding on sugar-cane, living normally on the Razor Grass (*Paspalum plicatum*) growing about the dams. The full grown larvae are somewhat like those of *D. canella* in general appearance, but can be distinguished from those insects by the presence of a rod-like black mark on the second segment instead of a triangular one as in *canella*.

Foodplants.

In addition to sugar-cane the species of Diatraea are known to feed on a number of other plants in this country such as Indian corn and rice, as well as a number of grasses.

Character of Injury.

The injuries caused by the small moth-borers to sugar-cane are not apparent at a casual examination. True, a number of joints may be observed to have been bored with small holes, but even these give no impression of any extensive damage. It is for this reason that the insects are all the more dangerous, for the planter is led to under-estimate the injury performed and to take a less serious view of the situation than it demands.

Effect on Young Canes. The first sign of the presence of moth borers in a field is the appearance in the young plants of what is known as "deadhearts." The term 'deadheart' well describes the injury, for it is characterised by the young central shoot becoming yellow and finally dry, the outer leaves of the plant remaining green, at least for some days after.

When the young plants are but a few inches high clusters of eggs of the moth-borer may be found on the leaves. These eggs hatch and the young larvae feed on the tender leaves of the central shoot for some time. The majority of the larvae perish during this period, for usually only one, but occasionally three or more, enters the young plant. First gnawing its way through the outer stem, the larva gradually eats its way into the interior of the shoot, cutting the tender inner shoot across. It is usually

some time before the injury is noticed, but cut off from the rest of the plant the central leaves gradually begin to wither, and eventually a typical 'deadheart' is formed.

All deadhearts in a field may not, however, be caused by moth-borers, for young canes are affected in this manner by various other causes, such as by someone accidentally stepping on a young shoot.

The Giant Moth Borer, *Castnia licus* Drury, also produces deadhearts in young canes, as also does the attacks of some fungi, in their initial stages, but with experience these can soon be recognised.

Effect on Mature Cane. While the injury to mature cane seldom proves fatal, the damage done is none the less important. As previously mentioned, the external signs of moth-borer injury is usually nothing more than a few small holes in the rind of the cane, which in reality gives no adequate idea of the amount of damage incurred. If, however, a stalk is split lengthwise it will be seen that these holes are but the openings of excavations, about one-eighth of an inch wide, made by the insects in the interior of the cane. In these tunnels the larvae of the moth-borer live, burrowing up and down the stem, and a mature cane may be found to harbour two or more such larvae at work in different parts of it.

More careful examination will often reveal further injuries by borings encircling the cane about the joints in such a way that the canes often break at these places.

Even when such damage occurs only in small quantities it has its ill effects, but where a large number of the joints of almost every cane are attacked the damage becomes important, and the resultant loss in tonnage of cane and manufactured sugar considerable.

A very important part of the injury occurs to the seedpiece or "top" of the cane. A large percentage of such 'tops' are infested with moth-borer larvae, and when these tops are planted without treatment the contained larvae form an important source of early infestation to the field.

That borer holes also serve as entrances for fungoid diseases has been pointed out by other workers.

The injuries caused by the small moth-borers may then well be summarised in the words of Holloway and Loftin who say that, "Cane badly bored is found to be "hard and dry, making it difficult to grind. The growth "is checked, and the bored stalks are often blown down "by a strong wind. The purity of the juice is lowered, "the tonnage decreased, and the sucrose content materially "diminished. The eyes are destroyed in many cases, "which lessens the value of the infested cane for seed."

Estimate of Losses.

Average Infestation.

For the purpose of obtaining an accurate idea of the amount of damage done by these insects, as well as to determine the annual status of the moth-borer and other sugar-cane insects, careful examinations were made of a number of fields. The method of examination adopted was a modification of that used by Holloway and Loftin in their investigations on the small moth-borer in the United States of America.

In each field one hundred stalks were examined, taken in five groups of twenty each at regular distances throughout the field. The number of stalks as well as the number of joints damaged was counted and the percentages worked out.

In estimating the number of joints damaged every joint with a borer hole was considered as damaged, and while it is fully recognised that a large number of such holes must be exit-holes, in view of the fact that a larva seldom bores a single joint, it is considered that this method can be taken as fairly representative.

From the figures obtained during such examinations it has been found that an average infestation of 93.0 per cent. of stalks, and 28.0 per cent. of joints attacked is not unusual. While the percentage of stalks damaged gives some idea of the amount of injury, a more accurate esti-

mate of the loss caused by the insects can be obtained when the percentage of joints damaged is also taken into consideration.

The lowest infestation was 11.0 per cent of joints attacked in a field of plant canes, while the highest infestation was in a field of old canes, of some nine years' standing, which showed 43.2 per cent of the joints attacked.

The question of the relationship of the ratooning period to the infestation of moth-borer will be dealt with elsewhere.

Infestation of Tops.

A very important part of the injury occasioned by small moth-borers is that which occurs to the seedpiece or "top" of the cane. When the cane has reached maturity it is this part of the plant that principally harbours moth-borer larvae, and if such tops are planted without treatment, as is the general rule, a large proportion of the larvae they contain continue their development in the tops after planting, either directly entering the young shoots as they spring from the top, or, emerging as moths, form a source of early infection to the young plants.

Many hundreds of tops examined showed that an average of 14.2 per cent of the tops are so infected. In examining such tops only tops that actually contained larvae or pupae at the time of examination were considered affected. Tops that had been bored but at the time contained neither larvae nor pupae were considered as unaffected and counted as such with borer-free tops. Of the "unaffected" tops 35.2 per cent showed such borings, so that only 50.4 per cent of the tops were sound. Of the infested tops 9.0 per cent were found to contain *canella* larvae, 3.7 per cent *saccharalis* larvae, and 1.5 per cent pupae.

Artificial Dissemination.

Early infection of Plant Fields from "Old Banks."

Artificial dissemination plays a very important part in the early infection of fields. Probably the most important source of early infestation in plant fields is to be

found in the "old banks," or "false rows" as they are sometimes called. When a field is replanted this is done between the rows of the old crop, and the old stools are not forked out till later, consequently shoots spring from them, forming the "false row" mentioned above. Very often these attain the height of three feet before the tops have sprung more than six inches. On occasions it has been observed that the old stools attained this height even before replanting was commenced, and it was necessary to weed the field preliminary to planting. These old stools soon become infested with borers and act as an important source of infection to the growing tops.

When the "old bank" has reached this height, if the stools are not required for "stumps," they are weeded down and thrown on the "trash bank" only to be a further danger to the tops. The borers they harbour, having their food supply thus suddenly cut off, either pupate, if they are far enough developed to do so, or leave the shoot and in their search for food enter the tops. If these trash banks be examined a few days after they have been weeded, they will be found to contain many such larvae' and as many as twelve full grown larvae, in a prepupal stage, have been found in one of these banks (a distance of 37 feet), while small larvae can be found trying to bore nto pieces of hard cane about the trash bank.

It is the general practice, whenever possible, to fork both banks in plant fields. Under the present system the new rows are forked and planted with tops, and after a period varying from one to several weeks one of the old banks is forked, the old stools being turned under. The trash, which up to the time has been on the other old row, is now transferred to the forked bank, the process being known as "changing banks." A further period then elapses, varying also to several weeks, before the second bank is forked. During the interval the remaining old stools spring to about three feet again, and, as before, harbour borers.

Table I. gives the results of examinations of three such fields and shows this early infestation from the old banks. The first examination was made when the rows

were about twelve inches high, the old bank at the time being two or three feet high, and in most instances was then undergoing weeding to allow the tops a chance. The second examination was made about a month later when the rows were about eighteen inches high, the old banks being then about the same height.

Table I.—Examination of Plant Fields showing Infestation of Rows from Old Banks.

Field.	Percentage of Shoots Infested. *1st Examination.*		Treatment of Field.	Percentage of Shoots Infested. *2nd Examination.*		Difference of Infestation.
	Row	Old Bank.		Row	Old Ba	
No. 1	4.9	No. O.B. Weeded down	One Bank forked already.	4.7		Nil.
No. 2	Nil	10.8 per cent. O.B just being weeded,	One Bank forked.	6.8	One O.B. remaining, 18 inches high. Infestation heavy; not estimated.	Increase 5.8
No. 3	2.7	7.7 per cent. Both O.B. present.	One Bank forked about 12 days before 2nd examination. Both O.B. weeded.	9.3	One O.B remaining, 18 inches high. Infestation heavy; not estimated, but gang working this field got most borers from O.B. See figures below.	Increase 6.6.

Further proof of this greater infestation in the field in which the old bank is left is given by the collections of the "gang" from these fields. These figures are given below.

Field	*Larvae collected*	*Clusters collected.*
No. 1	6,630	462
No. 3	19,910	1,732

It can be readily seen from the above that these old banks actually foster moth-borers, causing a much higher infestation in the plants than would otherwise occur.

The obvious thing to do is to fork both banks as soon as the tops are planted.

Planting Borer-free Tops.

Provided both banks are forked and the trash is buried, the next most important source of early infection in plant fields is the tops themselves. The selection of borer-free tops for planting has been recommended by Quelch and Moore, but it has been invariably objected to from the point of view of labour supply. It must be admitted that this is a serious drawback, and it is questionable if such selection could be practised on estates in the Colony at the present time.

Bearing this in mind it appeared that some method of treatment for seedcane would be necessary. Experiments on the treatment of seedcane have been carried out by Holloway and Loftin as well as others, but they did not prove effective in the destruction of moth-borer larvae. The treatment, however, in no instance extended for more than one hour.

Local conditions suggested the immersion of tops in water, for with a very complete system of canals as exist on estates in this colony, and punts for transportation, it would be both practical and cheap. With this object in

view experiments were carried out on the immersion of tops in vessels containing water for periods varying from twenty-four to seventy-two hours. The results of these experiments are given in Table II.

Table II. Effect on Moth-borer Larvæ of Immersion of Tops.

Time soaked hours.	No. of Tops soaked.	Number of Borers found.		Number of Borers killed.		Percentage Mortality.		Total Mortality %
		Larvae	Pupae.	Larvae.	Pupae.	Larvae.	Pupae.	
24	25	6		5				83·3
do.	100	10	2	9	2	90·0	100·0	91·6
do.	100	6	0	4	0	66·6	...	66·6
40	100	11	5	10	5	90·7	100·0	93·7
45	100	25	9	24	8	96·0	88·8	94·1
48	53	12	3	11	3	91·6	100·0	93·3
do.	375	103	43	85	43	82·5	100·0	87·6
do.	100	11	3	10	3	90·9	100·0	92·8
do.	100	5	0	5	0	100·0	...	100·0
62	203	21	8	18	8	85·7	100·0	89·6
72	200	13	7	12	7	92·3	100·0	95·0
do.	214	16	2	16	2	100·0	100·0	100·0
do.	365	12	4	12	4	100·0	100·0	100·0
84	377	23	7	22	7	95·6	100·0	96·6

It will be seen from the above that seventy-two hours immersion in water kills all the moth-borer larvae and pupae contained in the tops.

To test the effect of the immersion of tops on their germination, three punts of tops were submerged in a canal and after soaking for seventy-two hours the tops were planted out in a field. No attempt was made to treat the tops in any manner different from the treatment they would receive under practical conditions. The variety of cane used was D625. The germination of the soaked tops was then compared with the germination of adjacent un-

soaked tops. It was found that the soaked tops showed I per cent less deadhearts than the unsoaked ones. In addition, the number of shoots per top in the soaked tops was 2.9 as against 2.5 shoots per top in the unsoaked tops. The percentage of tops dead was greater in the soaked tops, being 10.3 per cent as against 9·4 per cent in the unsoaked tops.

Refuse Tops in Fields.

What is probably the most important source of early infection is to be found in the refuse tops left in fields. While the sources of infection just referred to, viz : from old banks, and tops used in planting, apply prinicpally to fields that are being replanted, the infection occurring from refuse tops left about fields takes place in ratoon fields, and probably forms the principal source of early infection of such fields. It also refers to plant fields when the tops discarded as being unfit for planting are left on the parapets of the fields, when such tops have not previously received some treatment for the destruction of the contained moth-borers.

It is the usual practice to cut tops whenever a field is being reaped, and after the canes have been removed, the tops remain in the fields for periods ranging to a couple of weeks or even more before they are collected for planting, and even after such collections are made, a large number of tops are still left in the fields, either as being unfit for planting or through oversight.

In order to demonstrate this point nine lots of twenty-five tops each were collected in the field and kept in the laboratory for observation, and after a month were examned and their conditions noted. The emerging moths were noted, and the tops were examined for any moth-borer larvae or other insects they might contain. Table III gives the results of these examinations.

Table III.—Examination of Tops to show their danger as a source of infection in ratoon fields.

Lot.	Date Cut.	Date tops collected.	Date examined.	Borer Free.	Moths emerged.	Larvae Alive.		Pupae Alive.	Empty Diatraes Borings.	Weevils	Wood-ants	Miscellaneous.
						Saccharalis	Canella					
No. i	28.xi.21	28.xii.22	28.xi.21	5	7	...	16	...	1	5	...	1 Diatraea pupa case
,, ii	21.xi.21	28.xi.21	28.xii.21	11	4	...	5	1	2	...	3 tops	3 Diatraea pupa cases
,, iii Refuse	21.xi.21	28.xi.21	28.xii.21	8	4	...	7	...	4	...	4 tops	3 Diatraea pupa cases
No. iv	26.iv.22	27.iv.22	26.v.22	16	...	...	4	1	5	1 Larva	...	
,, v Refuse	19.iv.22	27.iv.22	26.v.22	4	1 Canella	3	4	1	8	18 larvae 2 Pupae in 5 tops.	...	2 Diatraea pupa cases
No. vi Refuse	19.iv.22	27.iv.22	26.v.22	10	...	2	4	3	2	8 Larvae 7 Pupae in 7 tops.	...	Mealy-bugs alive on 1 top.
No. vii	26.iv.22	27.iv.22	27.v.22	11	...	5	9	...	2	8 Larvae in 3 tops	...	
,, viii	21.iv.22	27.iv.22	27.v.22	6	2 Canella 1 Saccharalis.	2	1	3	10	1 Larva 3 Pupae in 2 tops.	...	
,, ix	21.iv.22	27.iv	27.v.22	13	...	1	2	...	10	...	...	Mealy bugs alive on 1 top.

Lots I, IV, and VII were taken from fields that were then being cut. Lot II was taken from tops that had been collected and were being transported to another field for purposes of supplying; it further points to the necessity of the treatment of such tops before being used in this manner. Lots VIII and IX were tops that had been cut about six days previously and were left in the field, but were not discarded as being useless. Lots IV, V and VI consisted of tops that were left in the fields as refuse after a collection had been made. Lots IV and VII were from one field, lots V and VI from another, and lots VIII and IX from another, while lots I, II and III were from three different fields; in all six different fields.

These examinations showed that 23.1 per cent. of the tops contained *canella* larvae while only 5.7 per cent. contained *saccharalis* larvae. Of the total number of larvae found over 85 per cent were those of *canella*. Living pupae were contained in 3.5 per cent of the tops, and moths had emerged from 8.4 per cent. The borer-free tops comprised 37 per cent of the total number of tops, and 19 per cent possessed empty Diatraea borings. Weevils (*Metamasius hemipterus* L.) occurred in 8.4 per cent. and Woodants (Termites) in 3.1 per cent, while 0.8 per cent of the tops showed Mealy-bug (*Pseudococcus*) still alive.

It will be seen that the total number of tops as given in detail exceeds the total number of twenty-five tops for each lot, but this is explained by the fact that a single top often harboured more than one, or even one kind of insect.

Factors Influencing the Prevalence of Moth-Borers.

Stumping.

The habit of supplying fields with "stumps," as is often practised, cannot be looked upon in any other light than one fraught with dangers. Insect pests, such as *Castnia* and wood-ants, as well as fungoid diseases like *Marasmius*, are liable to be disseminated in this way, while from a purely agricultural point of view it would appear to be inadvisable.

It should be remembered that in planting stumps one is doing nothing more than planting into a field ratoons of the age of the field from which the stumps were obtained, often many years older than the field into which they are being planted. There is some little argument in their favour from this point of view when the supplying is being done to ratoon fields of some years' standing, but even this point disappears in the case of plant fields, while to plant entire fields of stumps would appear to me to have no advantage whatever.

It is realised that when the plants in a field have reached, say, five feet in height, supplying with tops is hardly advisable, but if supplying could not be carried out before this, the difficulty could be got over by using stumps raised from tops in a nursery or field set aside for the purpose, and not dug haphazardly from any field on the estate.

Ratooning Period.

From a number of estimates of infestations made during last year it would appear that the ratooning period and the infestation of borer show some relationship. Thus plant canes are invariably less affected than ratoons, the infestation gradually increasing year after year and attaining its highest point in "old canes." The average infestations during the year were found to be—Plant canes 20.9 per cent; 1st ratoons 26.6 per cent; 2nd ratoons 21.7 per cent; 3rd ratoons 25.1 per cent; and old canes 25.2 per cent.

The infestation varied somewhat and the percentages of joints affected were found to be, in plant canes from 11 to 29 per cent; in 1st ratoons from 19 to 37 per cent; in 2nd ratoons from 15 to 21 per cent; 3rd ratoons from 11 to 31 per cent; and old canes from 16 to 43 per cent. These figures, it must be remembered, are for one year only, and from a small number of fields, the error will therefore be somewhat high.

The amount of "old canes" in cultivation should therefore be reduced to a minimum, and should never be more than one-fifth of the total area under cultivation if

possible. In the same manner, plant canes, 1st, 2nd and 3rd ratoons should be of the same area; in other words the cultivation should be divided into five equal parts according to the ratooning periods.

From every point of view can be seen the advisability of replanting fields every five years at most, while periods of four years would be preferable. The practical planter often puts forward against this system the argument that if a field is giving a good return—and 2 tons per acre is considered a good return—why should it be replanted. The answer to this is but two other questions. How many fields of over five years' standing (4th ratoons) are giving 2 tons per acre? and, why not replant the field and get a greater yield which will more than repay the cost of replanting, and at the same time reduce the borer infestation?

It might even seem advisable to abandon some of the area under cultivation where necessary, and with a smaller area obtain the same total yield. The concentration of labour and expenditure would make for better cultivation and control, and probably a larger yield per acre, while the number of fields of old canes that are nothing but a drain on the returns would to a large extent disappear.

Many estates in the colony have as much abandoned land as there is in cultivation, and by taking adantage of this fact it would appear that more beneficial results could be obtained. If the area to be planted each year was taken from these abandoned long-rested or water-fallowed fields, instead of replanting fields that had just reached the fourth-ratoon stage, and which have possibly been in continuous cultivation for three times as many years, the yield of plant canes would probably be increased, while after six years there would be no field on the estate that had been in continuous cultivation for more than five years, so that even the old canes (4th ratoons) should be giving fairly remunerative returns.

Control Measures.

Collection of Egg-clusters and Larvae.

The method of control usually employed in this colony is that known as "cutting out." In this method a gang of children are employed to go through the fields cutting out the "deadhearts" caused by the moth-borer by means of sharp knives. Each shoot showing a deadheart is cut off close to the ground, opened, and the larva or pupa it contains removed and kept in a small tin until the end of the day when they are counted and destroyed. The insects are paid for by the hundred, the rate varying slightly according to their prevalence, being usually about six cents (3d.) per hundred. The number of individuals employed in this way varies considerably both according to the prevalence of the insects and the interest taken in the work by the management, but a gang of fifty persons is in no way unusual. The children employed at this work become very skilful at it, and often earn as good wages as do adults engaged in more arduous work.

Besides cutting out deadhearts these gangs invariably collect egg-clusters, doing much useful work in this manner. While collecting deadhearts they search the leaves of the cane for egg-clusters, which are removed intact with a piece of the leaf. These also are kept in small tins and counted at the end of the day. They are, however, not immediately destroyed as will be explained later. This part of the work is very important, and when carried out at the correct time cannot be too highly recommended. Egg-clusters are paid for at the rate of one or two for one cent (½d.)

Practically every sugar estate in the colony carries out these control measures, and it can be said that they are effective in keeping the number of borers in subjection, while the benefits derived from the work amply repay the cost of carrying it out.

While these methods of repression are sound, and can be said to have given good results, they are largely dependent upon an adequate supply of cheap labour, and therefore

cannot always be recommended. The success of such work, however, also largely depends on the continuous and systematic carrying on of it, and not waiting until fields show a large number of deadhearts before commencing work upon them, and then following no particular method but performing the work in a haphazard manner as is often done. With a well drawn up system not only are better results obtained but the size of the gang can be much reduced.

The mere collection of eggs and their subsequent destruction does not allow of the greatest efficiency being obtained from this part of the work, and not the least important part of such work is the returning of parasitized clusters that have been collected by the gangs to the fields from which they were obtained.

Under natural conditions in the field a number of the eggs laid are parasitized, and while they give no indication of this at the time, it follows that if the clusters collected by the gangs are destroyed immediately it would result in the destruction of very many parasites that would be of the greatest value in the field, thus considerably reducing the value of the work of egg-collecting.

It had been found that this can be avoided if the eggs collected by the gangs are kept for four days, at the end of which time any that had been parasitized in the field will have turned black, and such parasitized clusters can then be returned to the fields from which they were collected.

This method has been used by Quelch and Moore in their work in this colony. The method may be summarized as follows. Each day's collection of clusters is kept in a separate tin or saucepan, labelled according to the day of the week, the cover of the saucepan being slightly tilted to allow of the egress of any caterpillars that hatch within the tin. Each saucepan is placed in a shallow pan containing a mixture of water and kerosene or molasses, so that any larvae that emerge from the tins will crawl into the liquid and be destroyed. It is advisable to have a few holes bored about the bottom of the saucepan to allow of a circulation of air and so avoid over-

dampness in the tins and the growth of mould. After four days the eggs are examined, and any that have turned black are kept as being parasitized, the remainder being burnt, and the tin left empty to receive the collection of the same day of the following week.

The parasitized clusters are then placed in cigarette or other small tins, and returned to the fields from which they were collected. The tins containing parasitized clusters are put out in the field in small wooden boxes, eight inches square, opened at one side and hooked upon a stake about four feet in length driven into the ground.

The open side of the box should be away from the prevailing wind. Parasitized clusters should remain in the field about five days, after which time the parasites will have emerged, and the tins can be used for fresh supplies.

The procedure then is as under:—

Clusters collected on	Examined on	Parasitized clusters taken to field.
Monday	Friday	Saturday
Tuesday	Saturday	Monday
Wednesday	Monday	Tuesday
Thursday	Tuesday	Wednesday
Friday	Wednesday	Thursday
Saturday	Thursday	Friday

Collection of Parasitized Clusters before Reaping.

It can be readily seen that the method of burning fields previous to reaping, which is the general practice, must destroy a large number of insects in the fields. If this destruction worked equally against the moth-borer as against its enemies something might be said in its favour from this point of view. Unfortunately the very opposite is the case, and while the burning destroys a very large number of parasites, probably the majority of moth-borer larvae are unaffected by it. This fact is amply borne out by the number of larvae found in the tops alone.

When a sufficient supply of labour is available this waste of parasites can be largely avoided by sending a

gang through the fields, previous to burning, to collect the black parasitized egg-clusters. These clusters, on account of their coloration, are easily seen on the leaves, and a gang working conscientiously will bring in fair numbers. Care must be taken to see that eggs from which the parasites have already emerged are not accepted, for unlike those from which the larvae have emerged, they do not change colour after this has occurred, and they can only be recognised by the tiny emergence holes made by the parasites.

The parasitized clusters obtained in this way are sent to young fields in which the parasitism is not high and in such fields the parasites do useful work.

Biological Control.

The small moth-borers have several natural enemies in British Guiana and there is not the slightest doubt that they serve to keep the pest in control to a very large extent. The following is a list of those insects known to be parasitic on small moth-borers in this colony.

Egg Parasites.—*Trichogramma minutum* Riley.
Prophanurus alecto Cwfd.

Larval Parasites—*Iphiaulax medianus* Cam.
Iphiaulax sp.
Cremnops parvifasciatus Cam.
Mesostenoideus sp.
An undetermined species of Dexiid fly.

Pupal Parasite—*Heptasmicra curvilineata* Cam.

The biological control of small moth-borers appears to offer many possibilities in British Guiana, and for the past year the writer has been engaged on this work, especially in connection with the rearing of the egg-parasites, *Trichogramma minutum* Riley, and *Prophanurus alecto* Cwfd. Although the work has been in operation for only one year it has apparently been attended with favourable results. An account of the rearing of these parasites will be published at a later date.

Recommendations for the Control of moth-borers

1. The forking of both banks as soon as the tops are planted and the consequent elimination of "false rows" or old banks.

2. Treatment of tops previous to planting by immersion in water for 72 hours.

If the tops were so treated there would be no necessity for selection of borer-free tops for planting.

3. The destruction of refuse tops and pieces of cane left in the field, either by ploughing in or burning.

Such destruction of refuse would do much to eliminate attacks of weevil (*Metamasius hemipterus* L.,) and wood-ants (*Termites*), while if the "trash" was buried at the same time it would probably have a marked effect on the number of *canella* larvae through the destruction of their eggs.

4. The abolition of "stumping" as far as possible. Any supplying should be done with "tops" as soon as possible after planting.

5. The reduction of the acreage under "old canes" to a minimum, and where possible, such old canes not to exceed fourth ratoons. The replanting of at least one-fifth of the acreage yearly, such replanting to be carried out on long rested or water-fallowed fields and not in fields that have been in continuous cultivation for a long period of years.

6. The employment of gangs to collect egg-clusters and larvae of moth-borers from the fields. This method of control is still practical in British Guiana and should be employed until such other control measures are devised that can supersede it.

7. Returning of parasitized clusters collected by gangs to fields from which they were obtained. Where labour conditions allow the collection of parasitized clusters from fields previous to their being reaped and the distribution of such parasitized clusters amongst the fields that most need them.

8. The artificial rearing of the egg-parasites *Trichogramma minutum* Riley, and *Prophanurus alecto* Cwfd., as well as such larval parasites as *Iphiaulax medianus* Can., and the Dexiid fly parasite, is regarded as showing signs of promise as a practical means of control.

The investigations described in this paper were carried out during the past eighteen months while employed as entomologist to Messrs. S. Davson & Co., Ltd., Berbice. I should like to express my thanks to Mr. W. M. B. Shields, and especially to Mr. J. R. C. Gordon, as well as to Mr. A. E. DeGroot of that firm for the facilities given me while so employed, and to Mr. J. Crabtree, M.Sc., Superintendent of the British Guiana Sugar Planters' Experiment Stations, for the valuable criticisms and assistance given throughout the investigations.

THE FLOWER AND THE BEE.

A Very Important Link in Evolution.

By Professor J. Arthur Thomson.

One of the main trends of evolution has certainly been to link living creatures together, and one of the most important linkages in history has been that between flowers and useful insect visitors, such as bees. Useful because the bees, in getting pollen and nectar for their own purposes, bring about the cross-fertilization of flowers. And this cross fertilization improves both the quantity and the quality of the seed. Throughout long ages the flowers and the bees if we may keep to bees for a moment, have evolved together, and they are now fitted to one another as hand to glove. In many cases they are nowadays indispensible to one another, for many of the flowers are so specialized that they cannot be fertilized except by bees; while, on the other side, bees are so highly specialized that they would all come to an end if there were no flowers that produced nectar.

Virgin-Birth.

This linkage, like many another, must in some measure determine the lines of further evolution; for the flower cannot safely change in a direction that would shut the door on its visitors; and the bees cannot safely change in a direction that would lessen their success with the flowers. The linkage is part of the well-woven web of life, and it tends, like social linkages of a profitable kind, to keep things from sliding back. One must be cautious, however, for it is possible that without insects to pollinate them flowers might fall back on virgin birth (or parthenogenesis) and that seems to be occuring in such very successful flowers as dandelions. They still produce pollen, but it is not used.

Bees as "Good Botanists."

Inside the seed-box of a flower there are possible seeds or ovules, each containing a single microscopic egg-cell. The possible seed wiil not become a real seed that is to say, an embryo plant. unless this egg-cell is fertilized. Similarly, no one expects a chick to come out of the unfertilized egg of a hen, and the egg must remain unfertilized if there is no cock in the yard. The fertilization of the microscopic egg-cell of the plant depends on the dusting of the tip or stigma of the pistil with appropriate pollen-grains produced by the stamens of another flower of the same kind. Cases of self pollination, as in peas, oats rice, are in a minority; in most cases the pollen is carried from another blossom by insects or by the wind. A suitable pollen-grain, caught on the moist surface of the stigma, sends out a long tube which grows down to the ovule, and a male element—little more than one of the nuclei—in the pollen-tube enters into intimate orderly union with the microscopic egg-cell. In the maidenhair tree and a few other primative seed-plants the male element is a freely moving cell, as it is in mosses and ferns and in most animals. In all ordinary flowering plants the male element is a more or less passive cell borne to the egg-cell by the growth of the pollen-tube. But in all cases the essence of fertilization is the same the intimate union of male-cell and egg-cell; this is the beginning of a new individual.

But this is only an introduction to what we wish to get at—namely, an answer to the difficulty which must rise in the inquiring mind: How is it that the bees do not mix up pollens hopelessly as they pass from flower to flower? If a humble-bee dusts the pistil of a red-clover with the pollen of an aconite, the flower will not be "much forrarder." The answer is threefold. Some insects are specialists they know their flowers "like good botanists," and they keep to them consistently. But, secondly, even when the insect is not a specialist it tends on a given journey or forenoon to keep to one kind of flower. What Aristole observed, that bees do not

fly at random from one kind of blossom to another, has been amply confirmed. The mouth parts are suited for particular kinds of flowers; thus the hive-bee's tongue is not long enough to reach the nectar of the ordinary corolla of the red clover which is easily reached by the humble-bee.

News From Scouts.

Moreover, of a summer morning hive-bees pay considerable heed to the tidings brought in by the scouts, who inform them in some way or other which flowers are most profitable at the time. It must be remembered that true bees deal very intimately with the pollen-grains; they moisten them with their mouth and put cakes of them in a depression or basket on one of the joints of the hind-legs, and the next joint is enlarged into a hairy brush. The pollen that is of use to the next flower is the loose dust entangled on various appropriate parts of the bees body, appropriate in the sense that they knock against the stigma and deposit the grains there. Finally, it appears that foreign pollen dusted on to the stigma usually dies; only the proper kind of pollen sends out a pollen tube. Add these three points together—(1) the specialisms of insect visitors, (2) their consistency on a given journey, and (3) the specificity of the pollen, which only grows on its appropriate soil (the stigma of its kind), and you have the answer to the question: Why is there not a hopeless mixture of pollen.

How do the Insects "Know"?

But the next question is: How are insects guided to the profitable flowers, or how do they recognize them as the flowers they are out to visit on that journey? The answers given to this question have been so discrepant, some authorites laying emphasis on colour-sense, and others on the sense of smell, and others on memories which associate certain shapes and textures with abundant nectar, and so on, that we are glad to avail ourselves of Professor Bouvier's recently published "Psychic Life of Insects" Fisher Unwin, 1922), which takes a critical survey of the known facts.

Many observers have concluded that bees pay most frequent visits to flowers (or even baited paper) with gaudy colours; but there has rarely been any firm discrimination between colour as such and the brilliance of the reflecting surface. What counts for most is conspicuousness against the green back ground, and bees are in some measure colour blind! Uncovered flowers attract more visitors than the same flowers next door but shaded by leaves; higly coloured flowers with slight odour, like dahlias, attract more visitors than there fragrant unconspicuous neighbours, such as mignonette; conspicuous flowers get far more visitors than honey in a beaker next door.

The conspicuousness may depend on form and size as well as colour, as is shown by the attentions some butterflies pay to the big white flowers of the field convolvulus. The visits cease when the corolla is removed, though the nectaries remain intact. Yet after some time various kinds of insect visitors undoubtedly *learn* to come to honey-flowers whose petals have been cut off. This is a very suggestive fact.

"Never Trust To Colour."

Then there is fragrance, which certainly counts for much among hive-bees, for they are very richly endowed with smelling hairs. Darwin said that "bumble-bees and honey-bees are good botanists" because they recognise the same kind of flower though the colour is different. They obey the advice of the father of botany: "Never trust to colour." It is probably the flower's characteristic perfume, mainly due to essential oils, that enables the bees to become "good botanists." Kerner saw a convolvulus hawkmoth fly straight to the invisible flowers of a honeysuckle over a hundred yards away. For a long range, then, where colour, brilliant surface, and shape cannot count as guides, certain insects, like bees and moths, may be attracted by odours diffusing through the air. When they come near, the other influences may tell. On the other hand, a bee attracted to a flower by its conspicuousness may turn away when it detects the perfume.

The Role of Learning.

The question of the guidance of insect visitors to useful flowers has got into some confusion because different insects are differently attracted, and different flowers have different advertisements. Each case must be studied by itself. But there is more than that. Too little attention has been given to the capacity insects have of profiting by individual experience. They are not altogether instinctive automata; they are intelligent learners. They can attend and they can remember. They can build up associations between certain advertisements (colour, shape, fragrance) and good meals. Forel showed that bees *learn* to force their way into flowers covered up by leaves; Pérez showed that bees *learn* to visit the scarlet pelargonium, which they dislike, provided a little honey is introduced for a while into the corollas; Bouvier and others have shown that hive-bees *learn* to profit by slits and holes which other bees have made as short cuts to the nectaries; and many observers have noticed that bees *learn* to give up visiting flowers which promise well but are in reality disappointing. No doubt bees are dominated by their hereditary inborn instincts, but we fail to make sense of their behaviour unless we also give them credit for an intelligent criticism of advertisements.

CHEMISTRY AND THE DESTRUCTION OF PESTS IN AGRICULTURE.

By L. Carpenter, B.Sc., A.I.C.

The use of chemicals for the destruction of insect and fungus pests in agriculture is becoming more and more general in these days of intensive cultivation, and is, to-day, as important as the application of manures. Indeed, in one sense insecticides may be regarded as of greater importance than manures. For, if the farmer fails to dress his land with the appropriate fertilisers, he will still probably obtain a crop, if a poor one. But failure to spray a crop may result in its complete destruction. The writer knew of a case where failure to spray a mustard crop at a cost of some £12 resulted in its destruction and a loss of about £1,000; this will give some idea of the importance of spraying with a suitable agent.

Preparations of Arsenic.

Turning now to the various chemicals used, we find that there is a great variety of substances which find a use as lethal agents towards pests.

Of these arsenic in various forms is perhaps one of the most important. Arsenic in a soluble form is injurious to vegetation, causing scorching of the foliage. In certain insoluble forms, however, it is free from this objectionable property, whilst still remaining a powerful poison to insect life. Of these the arsenates of lead and calcium are examples, and lead arsenate is manufactured in large quantities for this purpose. It may be prepared by precipitating a solution of a soluble lead salt with sodium arsenate; the precipitate, which consists of a mixture of $Pb_3(AsO_4)_2$ and $Pb_2H_2(AsO_4)_2$, if filtered off, washed, and pressed until it contains not more than 50 per cent. of water; it is usually sold in this form as "50 per cent. paste." It is advisable to use sodium arsenate containing 70 per cent. As_2O_5, i.e., monosodium hydrogen arsenate, NaH_2AsO_4. Using lead nitrate the proportions are 2½ parts of this to one of arsenate; it is convenient to make the two solutions of equal bulk and as dilute as possible, for example, 10 per cent. lead nitrate

and 4 per cent. sodium arsenate, in order to obtain as fine and light a precipitate as possible; for the same reason the solutions should be mixed cold, and water as free as possible from mineral salts used. The solutions may be made up in separate wooden vats and run simultaneously through a common chute into a large mixing vat, also of wood. This arrangement ensures thorough mixing without the necessity of stirring the liquor to any great extent. Obtained in this way, lead arsenate forms a fine white suspension in water which settles quite slowly, a point of importance when it comes to spraying.

Another process consists in the direct combination of litharge with arsenic acid, a small proportion of nitric or acetic acid being added as a carrier. The product obtained with nitric acid, however, is too granular and tends to settle too quickly, but with acetic acid quite a satisfactory product can be obtained. indeed, the cruder the acetic acid the better the product from this point of view, probably owing to resinous impurities which act as reflocculents. The litharge, which should be of the fine yellow variety, and arsenic acid are mixed in a mixer, and the resulting thick, pasty mass ground with water in a pebble mill to obtain the requisite fineness.

An Electrolytic Process.

A third and very interesting method which at present, as far as the writer knows, has not been used on a manufacturing scale, consists in electrolysing a solution of a salt such as sodium chlorate or acetate, to which arsenic acid has been added between lead electrodes. The following reactions take place:

(1) $4NaClO_3 = 4Na + ClO_3$.

(2) $4Na + 4H_2O = 4NaOH + 2H_2$.

(At the cathode)

(3) $4ClO_3 + 2Pb = 2Pb(ClO_3)_2$.

(At the anode)

(4) $2Pb(ClO_3)_2 + 2H_3AsO_4 = Pb_2H_2(AsO_4)_2 + 4HClO_3$,

(5) $4HClO_3 + 4NaOH = 4NaClO_3 + 4H_2O$.

The amount of sodium cholrate, therefore, remains unaltered, the lead of the anode simply combining with the arsenic acid. The product is stated to be very uniform in quality and finely divided; especially is this so when using sodium acetate as the electrolyte.*

ADDITION OF LIME.

It is of great importance that all arsenic preparations should be as free as possible from soluble arsenic for the reason already given. Lead arsenate is sold under a guarantee of not more than 0. 5 per cent. soluble As_2O_5. In order to avoid excessive washing it has been suggested that lime or magnesia should be added in more than sufficient quantity to combine with the soluble arsenic (present as arsenic acid or sodium arsenate according to the method of preparation), thus forming insoluble basic arsenates. Tri-calcium arsenate is used sometimes in place of lead arsenate, being cheaper. It is made by slowly adding arsenic acid to hot milk of lime until the mixture is only faintly alkaline to phenol-phthalein; at no time may it show an acid reaction, as this would cause the product to be too high in soluble arsenic. For this reason calcium arsenate cannot be made by precipitating a solution of calcium salt by an arsenate because both mono- and di-calcium arsenates would be formed, both of which show too high a percentage of soluble arsenic.

Tri-calcium arsenate is less insoluble than lead arsenate, and in contact with air and moisture it slowly hydrolyses with the formation of arsenic acid. It is not, therefore, so safe to use as lead arsenate. It should be dried and not kept as a paste, and should be stored in air-tight tins. It has been mentioned that these preparations should be fine and light, so as to give good suspensions in water. For this reason deflocculents such as glue, soap, gum-arabic, etc., are sometimes added. These substances are harmless or even beneficial in making the product more adherent to the foliage; in addition soap itself is an insecticide. A good, lasting suspension causes a more even application to the trees.

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* For further particulars of this method see the *Journal of Industrial and Engineering Chemistry*, April, 1922, pp 311-313.

Uses of Arsenic Preparations.

Preparations of arsenic are used to destroy numerous pests of the leaf-eating variety, including the mustard beetle, asparagus beetle, and colorado beetle. They are essentially stomach poisons, acting upon the intestinal tract of the creature and are of no use upon pests which live in the substance of the plant. A 0.25—1 per cent. suspension in water is used according to the plant and the pest to be destroyed. They should not be used when the plant is in flower, as they are then liable to destroy bees. Applications are generally given one week after the blossoms fall. It is of great advantage to spray when the grubs are hatching, as the young are far more susceptible to the poison than the mature larvae.

Sulphide and Polysulphide Preparations.

Among these are the polysulphides of lime known as lime sulphur washes. The sulphur is mixed with boiling water, quicklime is added (slaked lime should not be used), and then more boiling water. A vigorous reaction ensues, and the whole is boiled until a filtered sample shows a specific gravity of 1.3 or slightly over, a result attained in about three-quarters of an hour Preparations are also made of a lower density, but the 1.3 liquor is most valuable, as it contains higher polysulphides than are present in the lower density liquors. A convenient proportion of ingredients to use is, 3 parts sulphur, 2 parts quicklime, 10 parts water, The liquor is red in colour and should be stored in iron tanks and not in wood as it quickly penetrates the latter; it may, however, be sent out in wooden casks for immediate use.

Lime sulphur is used as a winter and summer wash, the former at about three times the strength of the latter. It is a powerful fungicide and is used to destroy American goose-berry mildew and apple scab, In use it is diluted with from20 to 60 gallons of water (according to requirements) to each gallon of liquor. It belongs to the order of corrosive poisons of which other members are the sulphides of sodium and potassium; these are rendered

more effective by the addition of alkali such as soda ash, which destroys the waxy, protective coating of the insect.

OTHER PREPARATIONS.

Infusions of tobacco stalks which contain nicotine, as well as pure nicotine itself, are used to a great extent, and are frequently mixed with other insecticides such as lead arsenate and soap and sold under various trade names. Nicotine is a contact poison, being absorbed through the respiratory passages and pores of the insect. It is extremely effective against sucking insects such as red spider.

Preparations of phenols are used for sterilising soil, especially in vineries and tomato houses and for other crops under glass. A preparation containing phenol, caustic soda, and soluble oil is extremely powerful in its action and can only be used on soil containing no plants. A milder preparation, however of tar oil and soluble oil (added as an emulsifier) may be used on soil containing the roots of plants. These preparations destroy numerous soil pests such as wire-worms, slugs, and ants. Care must be taken in their use, however, as otherwise beneficient bacteria may be destroyed. Carbon bisulphide is also injected into the soil for the same purpose and is extremely effective. Naphthalene preparations are also dug in.

BORDEAUX AND BURGUNDY MIXTURES.

Mention may be made of Bordeaux and Burgundy mixtures. The former is made by precipitating a solution of copper sulphate with lime and filtering off the precipitate, which consists of a mixture of basic copper sulphate and calbium sulphate. The latter is similar, the lime being replaced by sodium carbonate; it forms a blue collodial solation which should be used before it settles. It is more liable to scorch than Bordeaux mixture. Both are used against potato blight. Copper sulphate. itself is used to prevent the disease known as "rust" in wheat.

Mention has already been made of soap as an insecticide. Mixed with other substances it serves to spread them more effectively, and by itself it acts slowly as a contact poison by clogging the respiratory passages of insects. Considerations of space preclude more than this very brief account of a branch of chemical industry perhaps not too well known but of great importance to agriculture and consequently to the world at large.

BOTANICAL IDENTIFICATIONS OF BRITISH GUIANA TREES AND PLANTS.

By L. S. Hohenkerk, Forestry Officer, Department of Lands and Mines.

In continuation of the list published in this Journal on pages 98 and 178 of the numbers for July and October, 1918, the following is a supplementary list of botanical determinations by the Kew Royal Gardens, London, of the trees and plants of British Guiana.

D.L.M. Record No.	Vernacular name and locality where collected,	Description.	Final determination at Kew from list supplied in 1921.
	ANONACEAE.		
452	Kadaburichi—Chimisi on Kara-kara ck., Demerara River.	Tree; yellow hard wood, slight aromatic odour.	*Guatteria Schomburgkiana*, Mart.
	Note :—The name of this tree was copied incorrectly from the original notes as Kudibutshi or Vogel Kop. The notes in the previous list on page 99 against this number and on page 183 against Nos. 171 and 465 should therefore be scored out.		
	COMBRETACEAE.		
79	Yarri-manni—Bonasika R. Essequibo R.	A vine trailing over bushes and trees. Conspicuous red flowers in long spikes. Fruit is poisonous and is used on lower Essequibo for poisoning bats.	*Cacoucia coccinea*, Aubl.
237	Nameless vine—Barima R., below Mt. Everard, N.W.D.	A climber with red flowers and yellow stamens.	*Combretum Aubletii*, D.C.
98	Coffee-mortar or Nah-aru (Warrow)— Kaituma R., N.W.D.	Large tree, grows on river banks and in swamps, not found on high land. Medium hard, pale yellow-brown sap wood and small dark heart, decays rapidly except under water.	*Terminalia*, near *T. Tanibouca*, Sm.

D.L.M. Record No.	Vernacular name and locality where collected.	Description.	Final determination at Kew from list supplied in 1921.
210	Nameless Tree—Gravel ck., Kaituma R., N.W.D.	... ...	*Terminalia,* near *T. Tambouca,* Sm.
390	Coffee-mortar or Naharu (Warrow)—Issororo, Aruka R., N.W.D.	Leaves similar to but much smaller than, No. 98.	do. do.
	MELASTOMACEAE.		
284	Dohiva—Pokorero creek, Kamuni R Dem. R.	Small tree 40 to 50 feet high; fruit edible.	*Bellucia grossularioides,* Triana.
192	Nameless tree—Kaituma R., N.W.D.	Tree 35 feet high.	*Bellucia sp.;* flowers required for determination.
82	Nameless shrub—Fort Island, Essequibo R.	Shrub 4 feet high with white flowers.	*Clidemia hirta,* Don., var. *elegans,* Griseb.
504	Nameless shrub—Demerara R.	Commonest and most abundant of flowering plants on savannas; purple-mauve flowers.	*Comolia vernicosa,* Triana.
235	Nameless shrub—Anabisi, Kaituma R. N.W.D.	Fruit an edible fig.	*Henriettea multiflora,* Naud.
80	Tara—below Bonasika, Essequibo R.	Small tree 10 to 40ft high, and spreading.	*Miconia guianensis,* Cogn. var. *ovalis,* Cogn.
81	Nameless shrub—Fort Island, Essequibo R.	Common on that Island.	*Miconia racemosa,* D. C.
216	Nameless shrub—Kaituma R., N.W.D.	Common on that river Fruit blue turning to black berry.	*Miconia nervosa,* Triana.
316	Nameless—Aria, Pomeroon R.	Tree or shrub? Grows in 'mainap'; resembles No. 81.	*Miconia sp.,* near *nervosa,* Triana. Material insufficient.
202	Nameless—Mt. Terminus, Barima R., N.W.D.	Small tree or shrub?	*Miconia fulva,* D. C.
293	Nameless shrub—Bonasika, Essequibo R.	Growing on river bank.	*Miconia prasina,* D. C.
501	Nameless shrub—Kara-kara, Demerara R.	Savannah plant; pink petals, pale yellow stamens, blue fruit.	*Miconia sp.*
326	Nameless plant—Arapiaku, Pomeroon R.	Growing on submerged fallen trees.	*Nepsera aquatica* Naud.
199	Nameless shrub—Moruka R.	From moist savannah	*Rhynchanthera dichotoma,* D. C.
241	Ants plant—Aruka R., N.W.D.	Cells at leaf base harbour small red ants.	*Tococa aristata,* Benth.

D.L.M. Record No.	Vernacular name and locality where collected.	Description.	Final determination at Kew from list supplied in 1921.
	MYRTACEAE.		
44	Kakeralli, Black variety, Amakura R., N.W.D.	Large tree; dark brown heart and lighter brown sap; very hard wood. Smooth, fibrous, dark brown bark. Grows on high land and sandy soil.	*Eschweilera laevifolia*, Miers.
142	Kakeralli, Hill variety, or 'Wena'—Aritak, Kamuni R., Dem. R.	Large tree; red brown heart & lighter coloured sap: hard wood. Thin, fibrous, somewhat scaly, reddish-brown bark. Pink flowers. Bast used as paper for making cigarettes.	*Eschweilera corrugata*, Miers.
490	Kakeralli, Hill variety, Christianburg, Dem. R.	Same as above.	*Eschweilera corrugata* Miers.
412	Kakeralli ? variety,—Little Timehri, Courantyne R.	Large tree. Large dark red flowers.	*Eschweilera sp.* near *pachysepala* Miers.
106	Kakeralli, white variety, (Kurumembiyu=A kawoi) Source of Kaituma R., N. W. D.	Large tree. Pink, medium size flowers; leaf has a wavy edge. The bark sembles that of Waduri, but is lighter in colour. Sap wood pale yellow and stringy.	*Lecythis chartaceae*, Berg.
114	Kakeralli, Black, small leaf variety. Kaituma R., N. W. D.	Large tree. Bark dark grey, scaly, medium thick and fibrous. Large dark heart; narrow light brownish sapwood, small shallow fruit.	*Lecythis venusta*, Miers.
111	Kwako—Anabisi, Kaituma R., N. W. D.	Tree 40 to 50 feet high, squares to 4 or 5 inches only; grows along river banks and margins of swamp savannahs. Bark very thin, dark and smooth: strips	*Marliera obtusa*, Berg.

D.L.M Record No.	Vernacular name and locality where collected.	Description.	Final determination at Kew from list supplied in 1921.
		off in lengths and has scattered knotty excrescences. Wood hard, claret-coloured heart and ill-defined narrow, lighter sap-wood.	
128	Ibbi-banaru, Kamuni R., Demerara R.	Small tree, not exceeding 3 ins. dia. And 30 ft. height. Hard, reddish wood. Bark thin, light grey, scaly.	*Myrcia splendens* D. C.
303	Nameless—H. M. Penal Settlement, Essequibo R.	Small tree, from second growth; fruit resembles Kwako No. 111.	*Myrtaceae.* Flowers required for identification.
429	Repe-repe-shi,—Manabadin, Demerara R.	Guava sp., grows on hill; stringy wood.	do. do.
178	Yawari-balli, H. M. Penal Settlement Essequibo R.	Spreading tree on river bank; grows to 12 ins. dia; wood used for building.	*Calyptranthes sp.*
307	Nameless,—H. M. P. Settlement.	Small tree growing on river banks.	*Calyptranthes sp.*
295	Kakreow (or Kakirio) Makauria, Essequibo R.	Grows on river banks, fruit said to be edible.	*Calyptranthes sp.*
313	Kakirio, or Wild Guava, — Kabakaburi, Pomeroon.	Fair sized tree, grows in forest and openings. Fruit a black berry said to be edible.	*Eugenia sp.*
377	Nameless, — Kabakaburi, Pomeroon R.	Small tree, apparently the same as No. 313.	*Eugenia sp.*
431	Wariru-bime, "Savan-pepper," near Manabadin, Dem. R.	Shrub from second growth; yellow-reddish fruit like a pepper.	*Eugenia sp.*
	RHIZOPHORACEAE.		
32	Mangrove— Issororo, Aruka R., N. W. D.	Growing in fresh water along river bank.	*Rhizophora mangle*, L.

CONCERNING YIELD DETERIORATION IN THE OLDER SUGAR COUNTRIES.

By Maurice Bird, B. Sc.

In the *International Sugar Journal* for last April Mr. F. I. Scard has a very interesting letter in which he discusses the susceptibility of the older cane growing countries to the ravages of insect and fungoid pests.

From many years' experience in various sugar countries where I have been engaged in more or less scientific work along the lines of growing and manufacturing sugar, I cannot but conclude that the susceptibility to disease is largely the result of starvation of the cane.

From a practical standpoint I have gone fairly deep into the analysis of soils, especially in British Guiana, both as regards their total plant food, and as regards the proportion of this which is available to the growing plant.

Now in Demerara the sugar soils are undoubtedly very rich in their reserves of plant food. Although some are said to have been in cultivation for a century, while the majority have apparently yielded very many harvests of cane, every sample which I have analysed (and my range has been pretty extensive) has shown sufficient *total* plant food to yield successive crops of cane for centuries to come.

When, however, we turn to the *available* plant food in these older soils they often tell a very different story.

To give a striking example of the partial exhaustion of the available plant food of a soil and its renovation, I was called on some years ago to examine some fields which after long cultivation would no longer produce paying crops. On analysis the soil of these fields was found to be so low in available or citric acid soluble potash, that in calculating this to a depth of 12 inches, and comparing the quantity thus found with the potash in an average crop of cane, it was evident that the roots of the cane would have to find, and assimilate, one seventh of the

total weight of the available potash existing at the time of analysis in order to produce a fair crop.

This seemed an unreasonable demand on the foraging power of the cane roots when the limited soil area with which these come in contact was considered, and so applications of potash was prescribed. Subsequently the manager of the estate remarked to me : "I am glad you recommended potash for those fields, for they are not only growing good cane now, but are free from marasmius." I had not known before that the cane was diseased; only that the crop was very short.

Again I was called to another estate which had what was thought to be "marasmius" on the half of one field and the whole of another. Samples were taken in a dozen places in each field. They showed abundance of plant food except as regarded phosphoric acid in the available form; this was extremely deficient where the disease existed, the total quantity being barely sufficient to give the phosphoric acid for *three* crops if every pound to a depth of 12 inches were utilized; while on the half of the field where the cane was healthy, there was abundance of every form of plant food in the available form, including phosphoric acid. Indeed of this element I calculated sufficient available to produce *thirty-three* crops of average yielding cane.

Another estate to which I am consulting chemist called on me last year to prescribe for 37 fields on all of which the crop was more or less deficient. On analysing their soils, every field, with a single exception, showed a low content of either available lime or available phosphoric acid; while in the case of the single exception noted this field had received phosphoric acid just before being sampled.

Another estate for which my predecessor and I made for years numerous soil analyses, from the standpoint of available plant food, and whose management manured more or less according to the soil requirements so ascertained, gave for 8 years an average yield of 2.69 tons sugar per acre, results far above the average for British Guiana.

There seems little doubt then that in many old soils the plant food is becoming available more slowly than is

demanded by the growing cane, and that unless artificial manure of the proper form is applied the land will yield an increasingly diminishing crop and like a starved animal will become more and more vulnerable to insect or fungoid pests. The important thing is to have a correct analysis of the soil, since, for instance, if this requires potash it is money thrown away to apply phosphoric acid.

Correct analyses and their proper interpretation entail painstaking care, but these will be well repaid by results. If on the other hand, this demand of nature is unheeded, I believe, abandonment of these older sugar lands will eventually become imperative.

It may not be out of place here to mention a very peculiar condition, which exists on many of the coastal estates of British Guiana, the importance of which is only now beginning to be recognized and which indirectly adds considerably to the exhaustion of the soil. Owing to the tenacity of the stiff clay which predominates, the internal drainage of the fields is very incomplete with ordinary drainage methods, with the result that the water underlying the surface of the soil becomes each year more heavily charged with the soluble ingredients of the decomposing oil. This soluble mineral matter sometimes amount to as much as one per cent. of the soil water. Since, in this compound alkaline carbonates of soda and magnesia predominate, considerable silica is dissolved from the soil, which entering the roots of the cane, is, I think, responsible for much of the low purity so characteristic of Demerara juice, as well as hindering a complete extraction of sugar in the factory.

All this means, of course, a greater tonnage of cane to make a ton of sugar, or in other words a more rapid exhaustion of the available plant food in the soil and consequently a still greater need of a scientific scheme, such as I have outlined, for maintaining a good reserve of all the elements of this same available plant food in the soil.

As Mr. Scard says, it is to be *hoped* that others, with long experience in cane cultivation, will further ventilate, and help to coalesce into active shape, this question of soil

renovation, which would appear to be one of paramount importance.

Canefield, Berbice, British Guiana.
June 30th, 1922.

[*International Sugar Journal.*]

HOW TO DESTROY LARGE JUNGLE TREES.

In clearing the jungle from an estate it is often a great source of trouble and expense to get rid of the large jungle trees. Too often does one see their stumps and roots remaining, a ready centre of fungus infection to the rubber trees just when they are beginning to bear at their best. The following note taken from the Indian Forester, May, 1920, may be of assistance to those about to clear jungle. Of course this method can only be employed whilst the tree is yet living.

" Where it is desired to destroy a tree without cutting it down, a hole is bored in the tree in a downward direction to the centre. For large trees an inch auger is used; for smaller ones ½ inch size is large enough. For large trees 1 oz. to 2 oz. of ordinary commercial saltpetre (nitrate of potash) is used, and for smaller ones ½ oz. to 1 oz. A plug is put into the hole to keep the rain from washing it out. The nitrate of potash is carried by the sap to the tips of the branches and the rootlets. If the tree is a large one, say, 2 feet or more in diameter, very little difference will be noticed in the foliage for 2 or 3 months, then the leaves begin to fall, and it assumes a bare wintry appearance. At the end of about 6 or 8 months a little brushwood is piled around the tree and lit; it will smoulder away to the remote ends of the roots, sometimes 30 feet away from the tree, leaving masses of valuable ash; the tree will fall, and when fallen it will continue to smoulder until every particle is converted into ash.—[" A Hand-book of Forestry " by A. D. Webster.] "

T. F. C.

ANTHRAX.

BY A. SETON MILNE, M.R.C.V.S., F.E.V.M.S.,
Government Veterinary Surgeon.

This is a disease common all over the world and is known in India by the name Loodianah, and in Manipur, Horse disease.

ANIMALS ATTACKED.

It may be said that Anthrax attacks all animals including man. Now what I would like to point out to the B.G. agriculturists is that often at one period of the year there is plenty of grazing to be had and at another the pastures are as bare as the public highway. The latter is the season which deceives the farmer. He finds an animal dead in the morning and says "poor brute died of starvation." Instead of dying of starvation it has more likely died of Anthrax. Instead of burning the carcase, it is allowed to lie till the carrion crows have eaten it. This is one of the many ways in which the disease is spread. Probably a week or more after the first case (and after several animals have died) the Government Veterinary Surgeon is notified. He proceeds to the plantation and finds it is Anthrax. Next procedure, quarantine and proposed vaccination—East Indians object, more delay—disease spreading—compulsory vaccination. In a few weeks the disease is stamped out after a large number have died that ought to have been vaccinated early. If the public would only notify the Board of Agriculture early the lives of hundreds of animals would be saved.

SYMPTOMS.

Usually the first intimation is that of a sudden death in the pasture or pen without any noticeable illness.

Temperature 105° to 106°.
Pulse 80 to 100.
Diarrhoëa accompanied with blood.
May be bloody discharge from nostrils.
Animal gets away by itself.

Shivers.
Arched back.
Staggering gait.

Seeing that nearly all cases are fatal, the only way of diagnosing the disease is by the use of the microscope. As a large number of cattle owners are East Indians who hold the cow sacred it is sometimes troublesome to persuade them to have their animals vaccinated. We had an experience like this a few days ago, but I am pleased to state it did not take very long to pursuade them to vaccinate. A few years ago a large number of people had their animals vaccinated yearly, but here as elsewhere if a few years pass and no deaths occur then they forget to vaccinate. Take my advice, brother colonists, and have your animals vaccinated yearly.

THE POULTRY INDUSTRY.

The following paper was read by Dr. F. C. Clarke before a meeting of the Barbados Poultry and Pet Stock Association held on Thursday, 29th June:—

Mr. President, Ladies and Gentlemen,—In selecting a subject for a paper on Poultry or Poultry-keeping the choice of subjects is very large, but I thought that as this is the first paper to be read before this Association a brief historical survey might be of interest.

It has been supposed that the breeds of domestic poultry as we know them have descended from a common ancestor, and that ancestor is supposed to be the wild fowl of Northern India, the Gallus Bankiva, a small fowl, small combed, clean legged, brilliantly coloured, very wild, and a very courageous fighter, whether in combat with other cocks or in defence of his hens or chicks against the many enemies that abound in the jungle. The hen is small, less brilliantly coloured than the cock, and lays clutches of only about a dozen eggs.

For the "game" they are indeed a fitting prototype, but it has been seriously questioned whether they can really be the ancestor of, say, the Brahma or the Cochin, so dissimilar are these latter in every particular from their supposed ancestor. The difficulty, however, is to find another ancestor, unless we suppose that there were many breeds of ancestral fowl which have all become extinct but one or two.

From Egypt comes the first definite mention of the domestic fowl and a poultry industry, and Herodotus describes the system of incubation as practised in his day, a system which obtains at the present time: the management of the incubators being handed down as a secret from generation to generation, in some cases as we know for over two thousand years.

The actual domestication of the wild fowl, however is lost in the mists of antiquity; and we must pass along to comparatively late Greek and Latin authors for anything more than a passing mention of the fact that domesticated fowls existed.

Pliny, who lived in the early years of the Christian era, and must have been a really great naturalist, tells us of barn door fowls and fighting fowls, that there were districts where the fattening of fowls was an industry, and others which were famous for their capons. The Romans on their arrival in Britain found barn door fowls, game fowls and geese, supposedly introduced first into Cornwall by the Phoenicians, and to this day in country districts in Cornwall fowls are sometimes called "Persian birds." The whole movement of fowls into Europe is apparently coincident with the successive waves of Aryan immigration which spread from North West Asia over Europe.

May I be allowed to make one quotation at length which contains facts of interest to those of us who breed Mediterranean fowls. Columella, a Latin writer of early Christian times, writes of a pure breed obtaining in Italy:—"The cocks should be lustful, tall, proud of carriage, with combs erect and of blood red,—ears very large and *very white* wattles looking white for their shining, and hanging down like a beard."

Two thousand years ago a breed of fowls existed that had one thing which is to-day common to all Mediterranean breeds, namely, white ear lobes, and something which has survived in one of those breeds,—the white-faced black Spanish.

Ladies and Gentlemen, the line of these breeds goes a long way back.

Then comes another long gap while Goth and Visigoth, and Frank and Hun, and Angle and Saxon and Jute, tore apart the civilisation that existed in those times, and gradually out of the dimness of the Middle Ages there emerge a few references.

Eggs in Edward the First's reign sold at 450 for 1s. 6d, in Edward the Second's at 20 for one penny, in Henry the eighth's at 1s. 2d. a hundred, and in 1619 they sold at 2s. for 50,—better and better for the producer.

There is really nothing much said about breeds until the early days of the 19th century, and then we

find emerging from the darkness a few definite pure breeds, not in the hands of a few breeders but being bred by districts. First, the Dorking (or Darking as the breed was then called, and the old five-toed Kent, Sussex and Surrey fowls. Games there were in abundance too of great purity of blood and long lineage.

I hope some one will read us an historical paper on the Game Fowl and its development, for nowhere are the principles of sound breeding for maintenance of vigour, fertility, shape and colour better illustrated than they are in this fascinating chapter in the history of poultry-dom.

Do not let us despise these old five-toed English farm breeds, for in the fifties of the last century one Dorking hen had 275 eggs to her credit in a year, and a Dorking cock was shown at 12 lbs.

The Spanish fowl was also known in England, and a fowl like the black Minorca was known under the name of the red-faced Spanish. Then in the thirties of the last century the Asiatic fowls arrived in England, first the Cochins, then the Brahamas *via* the United States, then the Langshan; and about 1835 the Leghorns were first introduced into America.

From this time the poultry industry and "the fancy" as we know it may really be said to have had its origin. And what an origin it was! Everybody went wild, and wild cat stories about marvellous performances of this breed and that breed flew plentiful and swift as teal duck in the first snowstorm. Every body crossed everything with everything else; farms which for generations had stuck to the old pure breeds crossed them up with Asiatics and Cornish Indians indiscriminately, and the result was "confusion worse confounded" and general deterioration.

The fancier is often even to-day sneered at as a man who does things only for his own profit, who cries always pure bred poultry in order to get people to buy his own stock. But out of this confusion which existed for many years who brought a semblance of order? Who caused a return to something like sanity? Who

showed that crossing should be done along definite lines and not haphazard? The fancier. By keeping to pure breeds and improving them, by working along definite lines with infinite patience and care in the development of new breeds, the fanciers saved the poultry industry from ruin; and when the craze for crossing had passed, as it did in a few years, he was able to restock the yards and farms with pure bred birds and give them something which would approximately reproduce its like from generation to generation.

And now we must turn our eyes away from the old country across the water. While in England men were busy ruining what they had, the United States, with the constructive ingenuity which is such a striking characteristic of the Yankee, were busy building up something of their own while working at the improvement of the already existing breeds, and their first gift to the world was the barred Plymouth Rock.

The thirty years from 1860—1890 witnessed the production of two great breeds, the Plymouth Rock and the Wyandotte. Asiatic blood was the foundation of these strains, crossed in the one case on the old Dominique, and in the other on the Dutch fowl or Homburgh.

The point which I am trying to emphasize, however, is the fact that from this point on, men worked with definite objects in view. They set an ideal of colour, shape and commercial quality in front of their eyes and worked steadily towards it. They met with many difficulties but finally these difficulties were overcome.

Then later came the Orpingtons, developed in England with an Asiatic foundation also. And the making of new breeds has no end. The last of the great breeds to be developed is, of course, the Rhode Island Red, and this one has been developed more by natural selection than by crossing.

The position is roughly as follows:

Of breeds developed in England the chief are the light and speckled Sussex, the Dorking, the Game, and the Orpington.

Breeds in the United States, the Plymouth Rock in its varieties, the Wyandotte and its varieties, and the Rhode Island Reds.

Breeds developed around the Mediterranean ; Leghorns, Minorcas, Spanish, Anconas, Andalusians, and Sicilian Buttercups.

These have all been taken to England and the States and developed there.

Breeds originating in Asia and developed elsewhere : Brahmas, Cochins, Langshans, Black Javas, Malays, Aseel.

Continental breeds: Campines, Hamburghs, Lakenvelders, Polish, Creve Coeur, La Fleche, Houdan.

I do not want to mention all of them. They are too well known to you and a longer string of names than I have given would only bore you.

There are many new breeds too which are fighting hard for admission to the Standard and have shown real merit. The ones referred to are the Rhode Island White and the Jersey Black Giant.

For a few years now there has been again a tendency not to keep the Poultry Ship off the Rocks of Faddism. The latest craze engineered really by war conditions is eggs and more of them. Very good; all of us are looking for eggs and more of them, but why merely for the sake of egg production should we give up the two great first objects in breeding, namely, vigour and breed, shape and type? Any hen which lays more than a certain number of eggs per year is being bred from irrespective of health, type and points, and that way lies disaster.

To breed for one thing only will take any breed and put it in the same position as the white-faced black Spanish. They were bred so much for face that they became all face. All they could produce was face ; and eggs, type, vigour, hardiness, all went into the rag bag. And if we leghornize our Rocks, Wyandottes and Reds and breed for eggs only, there is the same fate ahead of us.

We hear every day of some new egg record being made, Lady Bountiful or Miss Egg-producer or some such name with egg scores a mile high and affidavits yards long to back them. I have just had the pleasure of reading in the American Poultry Journal the experiences of two men who bought eggs from such terrific hens mated with cocks from dams which were almost as terrific as they. The result *nothing*: weak sickly things that did not do well, and scrubby pullets that were working jolly hard if they laid 100 eggs in their pullet year.

The lesson I wish to point out is that faddism spells disaster. Whether it be eggs, faces, ear-lobes, tails or any of the hundred things that one can breed for, if the great essentials of breeding are at the same time forgotten all lead eventually to disaster.

And now let us consider what we can learn from all this.

First. There is no such thing as *the best* breed. Each breed and sub-variety of breed has its own characteristics of colour, shape, size and commercial qualities. Every one must consider the qualities he thinks desirable in a fowl, weigh one breed against another in regard to those qualities and then: keep the breed that fills your eye and that you like.

Second. Breed from your best. Select for breeding, first, vigour, which includes quick growth. Secondly, breed shape and type. Thirdly, from your best layers. Fourthly, from those fowls which in combination with the other qualities enumerated above are best in points and feathering.

Third. Use breeding birds which are neither immature nor aged.

Fourth. Don't think that your birds because they are yours are the best. Keep in front of you the standard as set for the time being which governs the variety you are breeding and work towards it. Alywas give the other fellow's birds their due, and if they are nearer to the standard than yours say so and go and do better.

Fifth. Remember it is not all breed. There is such a thing as strain. Remember that in every breed there are certain strains which are acknowledged to be the best in that breed, and that every year new breeders are developing good strains.

Sixth. Be chary about new blood. Remember that there still exist some strains of game fowl that have been bred father to daughter, and son to mother, for over a century. They are still going strong. Often if you are not doing well with one strain it will pay you to dispose of your birds and keep another strain of the same breed. Do this rather than mix one strain with another.

Seventh. You can do nothing unless you are fond of your birds. No fancier can look on his birds as machines which will do certain definite things under certain circumstances and succeed. Kipling's lines on the Tommy's rifle are here very applicable. He said:

"She's human as you are
And treat her as sich
And she'll shoot for the young
British soldier."

Each bird has its own individuality; find it out, study it, handle it as though you understood it, and you will succeed.

RICE (*Oryza spp.*)

EDGAR BECKETT, F.L.S.

Rice, as everybody knows, has been in cultivation in this Colony for a number of years, the result of which is that there now exist thousands of varieties which differ from each other, not only in shape, colour and size, but also in the yield, habit of growth and character, and in quality. One can readily understand that some varieties require quite different methods of culture from certain other varieties, while some rices, rich in fats, are far superior to certain inferior varieties, the relative food constituents of which are poor.

Now the flat clay lands of our coast, with its underlying heavy impervious clay, furnish a really valuable soil for rice growing, and our grain used to be a most excellent one, especially the variety known as "*The Berbice Creole.*" The writer has noticed, however, that there are a number of varieties of inferior kinds which seem to have found favour with some farmers, and in a district in which he is interested, he has noticed that a red-grained renegade and a black-bearded variety appear to have been gaining ground.

Apparently there seems to have been some cross-fertilising. The result of this will be, if care is not taken by the farmer to select his seed, that we shall lose the pure strain known as "The Berbice Creole."

The Department of Science and Agriculture has repeatedly urged the importance of seed selection; amongst many other useful hints given by the District Agricultural Instructors this point has always been emphasized.

It is as well to emphatically point out the varieties that should not be planted. All varieties which are black in colour, should be avoided, since in this Colony, most of our rices are steamed before they are put through the huller—we are all familiar with the local brown rice, which is only white rice which has been steamed, the grain taking up its tinge of yellow from the husk. It can be

imagined, therefore, what kind of rice would be produced from dark-coloured padi which had been steamed.

Bearded rices should also be kept out of the cultivation, as they give trouble in the milling and yet more trouble in the winnowing.

It is a pity that the habit of "sighing" rice—as it is called locally, a word derived from the German through the Dutch, meaning to sow broadcast—is now so very prevalent. By this broadcast method, it is impossible with the means adopted by the local farmer, to get anything like a uniform sowing, and perhaps more important yet, any uniformity or regularity in the germination, since some seeds are bound to be too deep and others again too near the surface of the land. This lack of a uniform germination means that various stools reach maturity at different times, and results in the reaping or loss of unripened ears.

Birds, too, do more damage when seed is sown broadcast. It is not at all impracticable for farmers to set aside a portion of their field as a nursery for selected seed. One need not describe how such nursery beds should be prepared, since every rice farmer knows how to carry out this work, but many farmers who do utilise seed beds foolishly neglect to select their seed, and are careless, when transplanting, as to distances apart, and the number of seedlings to a hole.

If the seedlings are planted singly, or at most in bunches of two or three, there is generally a better "stooling," and a larger return of padi per acre. If it were possible to regulate the water supply so as to have a more or less continuous flow of water, with some control over its depth the yield of our padi per acre could not be rivalled by any other rice-growing country in the world. As it is, under the present most unsatisfactory conditions, our yield is one which can be envied by many a country which prides itself on the production of this cereal.

Though rice has been grown in this colony since its introduction somewhere about 1782, and was extensively cultivated by bands of runaway slaves, especially aback of Mahaicony, yet there is still a great deal our people have

yet to learn concerning not only its culture, but its preparation for the market. With respect to the latter aspect of the question, we consider that something should be done to protect the public from the poor rice that is often enough served up at one's table, while it is, in the writer's opinion, imperative that some means should be adopted to prevent the shipping of "bad" rice from this Colony.

An inspector of products is a necessity in other Colonies and in the Dominions, where markets are assured; it would seem that we, who are struggling to secure markets for our products such as rice, coconuts, &c., should be all the more on our guard to see to it that nothing but the best leaves our shores, and so build up a reputation for our products that, like our staple export sugar, we might hear of "British Guiana rice" as becoming as familiar a household word as "Demerara sugar."

COCONUTS.

THE ROOTS OF THE COCONUT PALM.

TRENT VALE.

There is a curious trait in the make-up of the human animal which impels it to seek to discover "what makes the wheels go round."

Few of us are content to take things as they are. As a general rule we are vastly more interested in the means than we are in the end. We start as little children by tearing out the inside of our gollywog to discover the source of the squeak in its tummy, and throughout our lives we are pursued by the same insatiable curiosity.

Of course this makes for progress. Research might not inaptly be defined as applied curiosity, and it is to the great investigators of the past that we owe the amenities of the present.

How things grow is one of the questions which has aroused the curiosity of man right from the year one, and it has led to more investigation and has been productive of a greater wealth of knowledge than probably any other problem with which we are confronted.

But much still remains to be done. It is the greatest mistake to imagine that we have arrived, or ever shall arrive, at a complete understanding.

Research in the past has taught us that the growth of plants is concerned with the absorption of food material through the leaves and the roots, and both of these organs have been subjected to the closest possible scrutiny, but whilst we are fairly clear as to general principles, comparatively little has been done by way of specialisation. We are somewhat apt to consider all roots as being similar to each other, to treat each and every type in the same way and to subject them one and all to the same rule-of-thumb method of cultivation.

There is indeed a remarkable similarity in the roots of the plants ordinarily cultivated by the farmer at home.

They develop either on the fibrous or the tap system, and they absorb air and solutions of various salts through their tiny root hairs.

But betweeen the roots of these plants and those of the coconut palm there is a world of difference, a difference as great as that between their above-ground appearances.

The Cocoanut palm sends out a number of roots which develop neither on the fibrous nor on the tap systems but in a manner peculiar to itself and its genus.

The actual number of roots put forth by this palm runs, in the case of a full-grown, healthy specimen, into several thousands.

These roots are remarkably uniform in size, being a little thicker than a pencil and not quite so thick as one's little finger.

They radiate outwards from the palm in every direction for a distance which varies chiefly according to the nature of the soil. In heavy land they are seldom found to be more than 15 feet, whereas 30 feet is not uncommon in poor thin sands.

Now in Ceylon the most usual number of palms grown per acre is in the neighbourhood of seventy, that is to say, the palms are about 24 feet apart, from which is follows that the roots of any one palm extends outwards until they reach and pass those of the adjoining palms. The entire area of the soil of an estate of full grown palms is therefore enmeshed in a network of roots. And from the fact that the primary roots give off secondary and tertiary laterals at some distance from the parent palm it follows that the soil exactly midway between two palms will contain more roots than are to be found in any other position.

This point is of the greatest importance when it comes to the question of applying manure because of the peculiar method in which the coconut-palm takes up food from the soil.

Unlike all other ordinary cultivated plants the coconut palm possesses no root-hairs. At the tip of each root is to be found the usual cap which protects the

tender growth-point and enables it to push its way through the soil.

Immediately behind this cap for a distance of not more than two inches is a light coloured, soft walled portion of root, and it is this portion only which is capable of absorbing food and water from the soil. Between this portion and the parent palm there may be fifteen or twenty feet of main root not one inch of which is of the slightest use to the palm as a means of taking up food from the soil. This long strand of root serves merely as a carrier through which the food absorbed by the end of the laterals growing from it is conveyed to the stem.

The usual method of applying manure to coconuts is to dig a trench either right round or, more frequently, half way round each palm. The trench is usually about two feet wide and the inner edge is generally not more than five or six feet away from the hole.

Theoretically this trench is supposed to be dug further and further away from the palm at each successive application of manure until the palms are full-grown, but on not one estate in a hundred is this theory ever put into practice.

Under this system the manure is applied to that portion of the soil in which the palm has put forth the smallest number of absorbing roots, with the result that it cannot, and does not, get the full benefit of the fertiliser.

Moreover it should be observed that manures should be applied in such a way as to encourage the largest possible development of the root system so that when the manure has disappeared the plant to which it was applied has become possessed of a larger number of absorbing roots and is thus better able to exact nourishment from the soil. The closer the manure is applied to the plant the more restricted is the area of soil in which possible root development can take place.

When the long strand-like roots of the coconut palm are examined a number of small, hard, white outgrowths will be observed dotted at irregular intervals along its length. These are special organs through

which the roots take in air, and their mere presence indicates the necessity for constant and thorough tillage of the soil whereby an adequate amount of air is permitted to come into contact with the roots.

Many estates in Ceylon are completely covered with grass, particularly in those districts where the heavier types of soil prevail.

On these estates one frequently sees cattle tethered to the palms, one cow to each palm, the idea being that the droppings from the cattle will serve to manure the coconuts.

As a matter of fact cattle are nothing more or less than an unmitigated pest on a coconut estate. They break away from their moorings and bite lumps out of the young supplies. And there must be something peculiarly acrid and unpleasant about the bite of a cow because no matter how carefully the youthful palm may be tended afterwards it persists in looking sickly and unhealthy, and in most cases it will pay in the long run to dig it out and replace it with an entirely new plant.

But altogether apart from the depredations caused as a result of the roving and destructive disposition of the animal a considerable amount of injury is done to the mechanical condition of the soil by the constant treading. In wet weather the soil around the palm is reduced to a sloppy, puddled mud through which neither air nor water can possibly penetrate, and this is baked as hard as cement during periods of drought.

If it were true that the cattle provided a large amount of valuable manure for the palms this might be considered as a set-off against the damage they do in other directions, but such is not the case.

When a cow is fed upon grass alone it retains a portion of the nutritive elements of the food and returns the remainder to the soil. It therefore follows that after a period of time the soil will actually be poorer than it was before the cow appeared on the scene. Not only does the cow fail to provide sustenance for the palm, it actually takes away nutriment which would eventually have served to feed the palm.

Cattle manure is an excellent thing for coconuts, but it must be provided by beasts which have been fed on other land and which have also received some kind of cake or corn.

Where the soil of a coconut estate is of a heavy clay or "kabooky" nature, and the cost of cultivation correspondingly great, it is unlikely that it would be a paying proposition to keep it clear of grass, but in such cases it would be easily possible to cultivate a swathe between each row of palms along which the soil could be ploughed and harrowed at frequent intervals so that the growth of weeds will be entirely prevented.

These lines of cultivated soil would serve to admit air to the roots and so obviate that partial suffocation of the palms which undoubtedly takes place on estates completely covered with grass.

The free admission of air into the soil would also assist in breaking down the insoluble mineral compounds and rendering them available to the palms.

In view of the fact that these swathes would lie directly over the area of greatest root development they would serve admirably for the introduction of manure, which could be broadcasted down the lines and subsequently ploughed under.

Such a scheme of cultivation as is outlined here would be entirely revolutionary, at least as regards Ceylon, and the question naturally arises as to how it comes about that the existing general method of cultivation should be so much at variance with the special requirements of the coconut palm.

This brings us back to the observation made at the commencement of this article, namely, that "whilst we are fairly clear as to general principles, comparatively little has been done by way of specialisation. We are somewhat apt to consider all roots as being similar to each other, to treat each and every type in the same way and to subject them one and all to the same rule-of-thumb method of cultivation."—INDIAN SCIENTIFIC AGRICULTURIST, Vol. 3, No. 6.

Meteorological Data—July to September, 1922.

Months	Rain-fall.	NUMBER OF DAYS OF RAIN						Evapo-ration.	Air Temperature and Humidity.			
									Air Temp.			
Botanic Gardens.	Total Inches.	Under ·10 Inch	·10 to ·50 Inch	·50 to 1.00 Inch	1.00 to 2.00 Inches	Above 2.00 Inches	Total days.	Inches	Maximum.	Minimum.	Mean	Humidity, Mean
July ...	7.45	4	13	6	...	...	23	4.63	85.0	75.4	80.2	80.2
Aug. ...	12.32	5	10	3	1	2	21	4.72	85.1	75.2	80.1	79.1
Sept. ...	4.02	6	4	...	...	1	11	5.40	87.0	75.9	81.4	77·8
Totals & Means.	23.79	15	27	9	1	3	55	14.75	85.7	75.5	80.6	79.0
Berbice Gardens.												
July ...	5.30	2	6	4	1	...	13	...	87.1	74.7	80.9	77.6
Aug. ...	13.22	3	7	3	2	1	16	...	86.9	74.0	80.4	81.8
Sept. ...	3.03	...	2	2	1	...	5	...	88.7	75.5	82.1	79.9
Totals & Means.	21.55	5	15	9	4	1	34	...	87.5	74.7	81.1	79.3
Onder-neeming.												
July ...	6.80	...	7	5	1	...	13	...	87.1	72.1	79.6	...
Aug. ...	6.01	...	11	3	1	...	15	...	87.3	72.0	79.6	...
Sept. ...	3.57	...	5	...	2	...	7	...	88.9	73.0	80.9	...
Totals & Means.	16.38	...	23	8	4	...	35	...	87.7	72.3	80 0	...
Mora-whanna												
July ...	19.21	4	6	4	5	3	22	...	...	...	...	...
Aug. ...	16.46	2	4	10	4	1	21	...	...	...	...	...
Sept. ...	16 17	2	6	4	4	2	18	...	...	...	...	...
Totals ...	51.84	8	16	18	13	6	61	...	...	...	...	...

ATTENDANCES AT THE DISTRICT GARDENS.

Year.	Bourda	Belfield, E. Coast.	Stanleytown, New Amsterdam	Suddie, Essequibo	Den Amstel	Houston, E Bank	Wakenaam	Total Attendance.
1912 .	5,514	4,395	3,302	2,100	2,544	2,156	1,718	21,729
1913 ...	5,156	4,535	2,519	3,399	2,568	1,836	1,319	21,332
1914 ...	4,243	3,869	2,443	3,025	1,791	1,653	1,533	18,577
1915 ...	1,123	1,006	769	59	503	339	401	4,209
1916 ...	4,705	1,161	1,510	225	623	2,251	1,297	12,026
1917 ...	4,991	2,820	1,366	3,297	1,186	2,564	1,663	17,086
1918 ..	4,834	3,081	1,653	2,671	2,162	2,790	2,067	19,258
1919 .	4,769	2,425	1,582	2,798	1,851	2,480	1,556	17,461
1920 .	6,285	2,312	1,665	2,525	2,532	3,228	2,148	20,695
1921 .	5,671	1,968	1,642	2,629	1,949	2,539	1,610	18,008
1922 .								
1st Quarter	1,010	532	435	637	510	490	350	3,964
2nd Quarter	708	306	366	317	355	274	261	2,587
3rd Quarter	980	406	342	404	350	450	509	3,441

EXPORTS OF AGRICULTURAL AND FOREST PRODUCTS.

Below will be found a list of the Agricultural and Forest Products of the Colony exported during first the nine months of 1922. The corresponding figures for the two previous years and the average for the four years previous to that are added for the convenience of comparison.

Product.	*Average 1916-19.*	*1920.*	*1921.*	*1922.*
Sugar, tons ...	58,329	49,501	59,283	59,591
Rum, gallons ..	2,831,947	1,188,175	1,799,349	371,986
Molasses, gallons ...	71,643	100	204	47,594
Cattle-food (Molascuit tons)	1,332	953	1,055	420
Cacao, cwts. ...	116	207	None	None
Citrate of Lime, cwts.	267	295	286	64
Lime Juice, gals. ...	8,621	2,641	3,850	1474
Essential Oil of Limes, gals. ...	228	236	463	427
Coconuts, thousands	1,629	2,639	1,999	1,271
Coconut Oil, gals. ...	12,617	12,176	11,326	23,937
Copra, cwts. ...	1,315	296	654	1,450
Coffee, cwts. ...	4,301	3,565	685	6,637
Kola-nuts, cwts. ...	11	9	None	None
Rice, tons ...	8,537	8,084	1,095	7,047
Ricemeal, tons ...	114	None	None	None
Cattle, head ...	383	4	None	409
Hides, No. ...	3,214	5,166	11,615	3,749
Pigs, No. ...	344	None	47	207
Sheep, head ...	14	66	26	81
Balata, cwts. ...	5,296	2,555	4,380	2,819
Charcoal, bags ...	35,008	35,749	39,174	39,312
Firewood, Wallaba, etc., tons ...	6,449	3,977	4,684	6,090
Gums, lbs. ...	764	3,361	8,792	None
Lumber, cub. ft ...	169,180	207,476	141,038	104,822
Railway sleepers, No.	10,714	10,707	5,212	14,846
Rubber, cwts. ...	107	130	14	None
Shingles, thousands	1,946	1,622	1,616	1,291
Timber, cub. ft. ...	62,919	57,088	114,413	96,405